

EXHIBIT H

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: Marcos C. Tzannes) Group Art Unit: 2465
)
Application No.: 12/783,777) Examiner: HO, Duc Chi
)
Filed: May 20, 2010) Confirmation No.: 7487
)
Atty. File No.: 5550-16-CON-3)
)

For: SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL

AMENDMENT AND RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

Applicant submits this Amendment and Response to address the Office Action having a mailing date of August 16, 2012. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Drawings begin on page 3 of this paper.

Amendments to the Claims are shown in the listing of claims which begins on page 4 of this paper.

Remarks begin on page 7 of this paper.

Amendments to the Specification:

Attached hereto is a marked-up and clean version of a substitute specification.

No new matter has been added.

Amendments to the Drawings:

The attached drawing sheet(s) include(s) new Figure 16.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-14. (Cancelled)

15. (Currently Amended) A method to combine multiple DSL transceivers to generate a single high data rate connection between a service provider and a DSL subscriber over a plurality of twisted pair communications channels comprising:

utilizing determining at least one transmission parameter value, for each of the multiple DSL transceivers, to reduce a difference in latency between the multiple DSL transceivers; and transmitting a plurality of packets or cells from the service provider to the DSL subscriber utilizing the at least one transmission parameter value, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

16. (Previously Presented) The method of claim 15, further comprising receiving, at the DSL subscriber, the plurality of cells or packets using multiple DSL transceivers.

17. (Previously Presented) The method of claim 15, wherein the cells are ATM cells.

18. (Previously Presented) The method of claim 15, wherein the packets are IP packets or Ethernet packets.

19. (Previously Presented) The method of claim 15, wherein the DSL transceivers are ADSL transceivers or VDSL transceivers.

20. (Previously Presented) A system, capable of combining multiple DSL transceivers to generate a single high data rate connection between a service provider and a DSL subscriber over a plurality of twisted pair communications channels, comprising:

multiple DSL transceivers, each of the multiple DSL transceivers capable of utilizing at least one transmission parameter value to reduce a difference in latency between the multiple DSL transceivers; and

a plurality of transmitter portions capable of transmitting a plurality of packets or cells from the service provider to the DSL subscriber, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

21. (Previously Presented) The system of claim 20, further comprising a receiver portion capable of receiving, at the DSL subscriber, the plurality of cells or packets.

22. (Previously Presented) The system of claim 20, wherein the cells are ATM cells.

23. (Previously Presented) The system of claim 20, wherein the packets are IP packets or Ethernet packets.

24. (Previously Presented) The system of claim 20, wherein the DSL transceivers are ADSL transceivers or VDSL transceivers.

25. (Currently Amended) A non-transitory computer readable information storage media having stored thereon instructions that when executed cause to be performed a method to combine multiple DSL transceivers to generate a single high data rate connection between a service provider and a DSL subscriber over a plurality of twisted pair communications channels comprising:

utilizing~~determining~~ at least one transmission parameter value, for each of the multiple DSL transceivers, to reduce a difference in latency between the multiple DSL transceivers; and

transmitting a plurality of packets or cells from the service provider to the DSL subscriber utilizing the at least one transmission parameter value, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

26. (Previously Presented) The one or more media of claim 25, further comprising receiving, at the DSL subscriber, the plurality of cells or packets using multiple DSL transceivers.

27. (Previously Presented) The one or more media of claim 25, wherein the cells are ATM cells.

28. (Previously Presented) The one or more media of claim 25, wherein the packets are IP packets or Ethernet packets.

29. (Previously Presented) The one or more media of claim 25, wherein the DSL transceivers are ADSL transceivers or VDSL transceivers.

REMARKS

Applicant respectfully requests reconsideration of this application as amended.

Claims 15-29 are pending.

The Examiner is thanked for the indication that claims 20-24 are allowed and that claims 16-19 and 26-29 contain allowable subject matter.

By this amendment, new Fig. 16 has been added that, as requested by the Examiner, includes the steps of claim 15. Literal and direct support for this figure can at least be found in paragraphs 52, 6, 39, 40, 43 and 44 of the originally filed specification.

Additionally, the specification has been updated to include reference to the new figure, again, with literal and direct support being clearly found in at least the above referenced paragraphs. Marked-up and clean versions of the specification are attached hereto.

Withdrawal of the objection to the drawings is therefore respectfully requested.

Regarding the rejection under 35 U.S.C. §112, second paragraph, the rejected claims have been amended to include a direct correlation between the steps. Withdrawal of the rejection is therefore respectfully requested.

With all objections and rejections having been overcome, Applicant respectfully submits the application is in condition for allowance. A prompt notice of allowance is respectfully solicited.

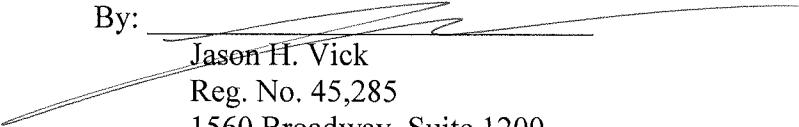
Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is encouraged to contact Applicants undersigned representative at the telephone number listed below.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 4 Sept '12

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SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL

RELATED APPLICATION DATA

[0001] This application is a Continuation of U.S. Application No. 12/769,277, filed April 28, 2010, now U.S. Patent No. 7,978,706, which is a Continuation of U.S. Application No. 12/247,741, filed October 8, 2008, now U.S. Patent No. 7,809,028, which is a Continuation of U.S. Application No. 10/264,258, filed October 4, 2002, now U.S. Patent No. 7,453,881, which claims the benefit of and priority under 35 U.S.C. §119(e) to U.S. Patent Application Serial No. 60/327,440, filed October 5, 2001, entitled “Multi-Pair ATM Over DSL,” each of which are incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The systems and methods of this invention generally relate to communication systems. In particular, the systems and methods of this invention relate to asynchronous transfer mode (ATM) over digital subscriber line (DSL).

Description of Related Art

[0003] Fig. 1 illustrates the conventional configuration of a system for transporting ATM over DSL using a single latency ADSL configuration. As of the time of filing, single latency is most common form of ADSL deployment. Further details of this specific architecture can be found in DSL Forum Recommendation TR-042, incorporated herein by reference in its entirety.

[0004] For the system illustrated in Fig. 1, the access node 10 serves as an ATM layer multiplexer/concentrator between the ATM core network 2 and the access network. As described in the above referenced DSL Forum Recommendation, for

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ATM systems, the channelization of different payloads is embedded within the ATM data stream using different virtual paths (VP) and/or virtual channels (VC). In the downstream direction, the VP/VC Mux module 16 and VPI/VCI translation module 14 receive cells from the core network interface element 12 and function to perform cell routing based on a virtual path identifier (VPI) and/or virtual channel identifier (VCI) to the appropriate ATU-C 18. In the upstream direction, the VP/VC Mux module 16 and the VPI/VCI translation module 14 function to combine the cell streams from the ATU-C's 18 into a single ATM cell stream to the core ATM network 2.

[0005] The broadband network termination (B-NT) 100 performs the functions of terminating the ADSL signal entering the user's premises via the twisted pair cable and the ATU-R 22 and provides either the T, S or R interface towards the premises distribution network/ terminal equipment 4. The access ATM module 26 and the VP/VC Mux module 24 perform the ATM layer functions to support the TC layers in the ATU-R. The broadband network termination 100 may also contain VPI/VCI translation functions to support multiplex/demultiplex of VC's between the ATU-R 22 and the premise distribution network/terminal equipment 4 on a VPI and /or VCI bases. The broadband network termination 100 may also comprise a PDN/TE interface element 28 and SAR module 30 the functions of which are well known and will be omitted for sake of clarity.

SUMMARY OF THE INVENTION

[0006] The exemplary systems and methods of this invention combine multiple DSL PHY's, i.e., multiple twisted wire pairs, to, for example, generate a high data rate connection for the transport of an ATM cell stream between the service provider and, for example, a DSL subscriber. The ATM cell stream may contain one or more payloads where each payload is channelized within the ATM data stream using

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different virtual paths (VP) and/or virtual channels (VC). At a transmitter, the ATM cell stream received from the ATM layer is distributed on a cell-by-cell bases across the multiple DSL PHY's. At the receiver, the cells from each DSL PHY are re-combined in the appropriate order to recreate the original ATM cell stream, which is then passed to the ATM layer.

[0007] Accordingly, aspects of the invention relate to ATM communications.

[0008] Additional aspects of the invention relate to transporting ATM over DSL, and more particularly over ADSL.

[0009] Additional aspects of the invention also relate to distributing ATM cells from a single ATM cell stream across multiple twisted wire pairs.

[0010] Further aspects of the invention relate to distributing ATM cells from a single ATM cell stream across multiple DSL communication links.

[0011] Further aspects of the invention relate to varying data rates over the multiple twisted wire pairs over which distributed ATM cells are transported.

[0012] These and other features and advantages of this invention are described in, or apparent from, the following detailed description of the embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The embodiments of the invention will be described in detail, with reference to the following figures, wherein:

[0014] Fig. 1 is a functional block diagram illustrating a conventional ATM over ADSL system;

[0015] Fig. 2 is a functional block diagram illustrating an exemplary system for

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transporting ATM over ADSL according to this invention;

[0016] Fig. 3 illustrates an exemplary functional block diagram of the multi-pair multiplexing transmitter according to this invention;

[0017] Fig. 4 illustrates a functional block diagram of a second exemplary multi-pair multiplexing transmitter according to this invention;

[0018] Fig. 5 illustrates a functional block diagram of a third exemplary embodiment of the multi-pair multiplexing transmitter according to this invention;

[0019] Fig. 6 illustrates a functional block diagram of an exemplary multi-pair multiplexing receiver according to this invention;

[0020] Fig. 7 illustrates a functional block diagram of a second exemplary multi-pair multiplexing receiver according to this invention;

[0021] Fig. 8 illustrates a functional block diagram of a third exemplary multi-pair multiplexing receiver according to this invention;

[0022] Fig. 9 is a functional block diagram illustrating a fourth exemplary multi-pair multiplexing receiver according to this invention;

[0023] Fig. 10 illustrates a functional block diagram of a fifth exemplary multi-pair multiplexing receiver according to this invention;

[0024] Fig. 11 illustrates a functional block diagram of a fourth exemplary multi-pair multiplexing transmitter according to this invention;

[0025] Fig. 12 is a functional block diagram illustrating a sixth exemplary multi-pair multiplexing receiver according to this invention;

[0026] Fig. 13 illustrates a standard five byte ATM UNI header;

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[0027] Fig. 14 illustrates an exemplary modified ATM header according to this invention; and

[0028] Fig. 15 is a flowchart outlining an exemplary embodiment of a method for combining multiple DSL PHYs to transport an ATM cell stream between a service provider and a subscriber.

[0028][0029] Fig. 16 is a flowchart illustrating an exemplary method for reducing latency between DSL PHYs.

DETAILED DESCRIPTION OF THE INVENTION

[0029][0030] The exemplary systems and the methods of this invention will be described in relation to digital subscriber line communications and more particularly to asymmetric digital subscriber line communications. However, to avoid unnecessarily obscuring the present invention, the following description omits well-known structures and devices that may be shown in block diagram form or otherwise summarized. For the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It should be appreciated however that the present invention may be practiced in variety of ways beyond the specific details set forth herein. For example, the systems and methods of this invention can generally be applied to any type of communications system including wireless communication systems, such as wireless LANs, power line communications, or any other systems or combination systems that use ATM.

[0030][0031] Furthermore, while the exemplary embodiments illustrated herein show the various components of the communication system collocated, it is to be appreciated that the various components of the system can be located at distant portions of distributed network, such as a telecommunications network and/or the Internet, or within a dedicated ATM over DSL system. Thus, it should be appreciated

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that the components of the communication system can be combined into one or more devices or collocated on a particular node of a distributed network, such as a telecommunications network. It will be appreciated from the following description, and for reasons of computational efficiency, that the components of the communication system can be arranged at any location within a distributed network without affecting the operation of the system.

| {0031}{0032} Furthermore, it should be appreciated that the various links connecting the elements can be wired or wireless links, or a combination thereof or any other know or later developed element(s) that is capable of supplying and/or communicating data to and from the connected elements. Additionally, the term module as used herein can refer to any know or later developed hardware, software, or combination of hardware and software that is capable of performing the functionality associated with that element.

| {0032}{0033} Additionally, although this invention will be described in relation to ATM systems, the systems and methods of this invention can be applied to any transport protocol that uses cells or packets for transmitting information. Therefore, for example, the same methods can be used for the bonding of PHYs that transport Ethernet or IP packets. Furthermore, although this invention will be described in relation to ATM transported over DSL PHYs, other PHYs, such as cable, voice band modems, ATM-25, and the like, can also be used.

| {0033}{0034} Fig. 2 illustrates an exemplary multi-pair ATM over DSL system. In particular, the system comprises an access node 100, a broadband network termination 200, an ATM core network 2 and premise distribution network/terminal equipment 4. The access node 100 further comprises a core network interface element 110, a VPI/VCI translation module 120, a VP/VC Mux module 130, an ATU-C multi-pair multiplexer 140 and a plurality of ATM TC ATU-C modules 150. The broadband network termination 200 further comprises a plurality of ATU-R ATM TCs 210, an ATU-R multi-pair multiplexer 220, a VP/VC Mux module 230, an

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access ATM module 240, and a PDN/TE interface module 250. Furthermore, the system comprises a SAR and PDN function module 260, wherein the functions of like components have been discussed in relation to Fig. 1.

{0034}{0035} The exemplary system illustrated in Fig. 2 distributes ATM cells from a single ATM cell stream across multiple ADSL PHY links, i.e., multiple twisted wire pairs (1 to n). The ATM cell stream, also referred to as the ATM stream, may comprise one or more payloads where each payload is channelized within the ATM stream using different virtual paths (VP) and/or virtual channels (VC). This can effectively create, for example, a high data rate ATM connection between a service provider and an ADSL subscriber.

{0035}{0036} In accordance with an exemplary embodiment of this invention, the ATU-C multi-pair multiplexer 140 is inserted between the VP/VC multiplexer 130 and the ATU-C's 150 at the V-C interface in the access node 100. Additionally, the ATU-R multi-pair multiplexer 220 is added to the broadband network termination 200 at the T-R interface. Both of these multi-pair multiplexers have transmitter and receiver sections (not shown) whose operations are comparable. The multi-pair multiplexer transmitter section performs the task of distributing cells from the ATM stream among multiple ATM cell substreams. Each ATM cell substream, also referred to as an ATM substream, is forwarded a different ATU. The multi-pair multiplexer receiver section performs the task of recombining the ATM substreams to regain the original ATM stream.

{0036}{0037} In the exemplary system illustrated in Fig. 2, two ADSL PHYs 160 and 170 are “bonded” together to transport a single ATM cell stream. However, it should be appreciated, that the number of ADSL PHYs “bonded” together can be easily expanded to any number ($N \geq 2$) of ADSL PHYs thereby, for example, enabling higher ATM data rates. In addition to the two ADSL PHYs 160 and 170 that are bonded together, it should further be appreciated that in some instances in the same access node 100, other ADSL PHYs may be operating in the traditional way. Obviously, the

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ADSL PHYs operating the traditional way do not need to be connected to the multi-pair multiplexer 140. Thus, in general, it should be appreciated that any combination of “bonded” and unbonded, i.e. traditional, ADSL PHY’s, may be configured between the access node 100 and the broadband network determination 200. Furthermore, it should be appreciated that all of the ADSL PHYs can be bonded together.

[0037][0038] In many ADSL systems, the logical interface between the ATM layer and the PHY is based on UTOPIA Level 2 with a cell level handshake. This same UTOPIA Level 2 logical interface can also be used between the multi-pair multiplexer and the ATM layer and also between the multi-pair multiplexer and the PHY in the access node 100 and the broadband network termination 200. Although, the above example and the remainder of this discussion will be directed toward the multi-pair multiplexer functions using a ADSL PHY, any version of DSL that has an ATM-TC, e.g., VDSL, SHDSL, or the like, may be used instead of, or conjunction with, the ADSL PHY.

[0038][0039] Fig. 3 illustrates an exemplary multi-pair multiplexing transmitter according to this invention. The ATU-C and ATU-R multi-pair multiplexer box provide the same basic transmitter and receiver functions and thus can be summarized as one unit.

[0039][0040] In particular, the exemplary multi-pair multiplexing transmitter 300 illustrated in Fig. 3 provides, but not limited to, accepting a single ATM stream 310 from the ATM layer and distributing the cells among N ATM substreams 320, where $N \geq 2$. Furthermore, the multi-pair multiplexing transmitter 300 maps each ATM cell substream to a different DSL connection and provides as output these ATM cell substreams to the appropriate ADSL PHY (ATUx). For the exemplary multi-pair multiplexing transmitter 300 illustrated in Fig. 3, the cells from the ATM stream 310 are distributed amongst the ATM substreams 320 based on the data rate of each DSL PHY.

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{0040}{0041} The configuration of the multi-pair multiplexing transmitter 300 can be varied to, for example, provide an equal or unequal data rate on the DSL PHYs. Fig. 4 illustrates an exemplary embodiment where an equal data rate is applied to all of the DSL PHYs. In particular, if the data rate on all of the DSL PHYs is the same, then an equal number of ATM cells will be transported over every PHY connection. In this case, the multi-pair multiplexing transmitter 300 sends the first ATM cell to ATU1 330, the second ATM cell to ATU2 340, the third ATM cell to ATU3 350, and so on. For the multi-pair multiplexing transmitter 300 illustrated in Fig. 4, $N=3$ and an equal data rate on all DSL PHYs is illustrated, therefore the input ATM cells from the ATM stream 310, as discussed above, are distributed equally and sequentially among the DSL PHYs.

{0041}{0042} For the multi-pair multiplexing transmitter 300 illustrated in Fig. 5, an unequal data rate is transported on the DSL PHYs. In particular, if a data rate on all the DSL PHYs is not equal, the ATM cells can be forward to the DSL PHYs, at, for example, a ratio that matches the ratios of the available PHY data rates. If, for example, $N=2$, as illustrated in Fig. 5, and the data rate of the first DSL PHY 360 is two times the data rate of the second PHY 370, then the multi-pair multiplexer 300 would send 2 ATM cells to the first DSL PHY, i.e., cells 1 and 2, and then send 1 ATM cell to the second DSL PHY, i.e., cell 3. However, in general, this basic concept can be expanded at least to include the situation where $N>2$ and to non-integer data rate ratios.

{0042}{0043} For example, in a two modem environment where there is a “high-speed” and a “low-speed” implementation, an exemplary ratio of $N:1$ where $N=2$ to 8 can be specified. This means that the “high-speed” modem will have eight times the cells as the “low-speed” modem. In this exemplary configuration, there are eight cells of receiver FIFO meaning that the entire “high-speed” receiver could be emptied before needing to service the “low-speed” receiver.

{0043}{0044} Fig. 6 illustrates an exemplary multi-pair multiplexing receiver 400.

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The exemplary multi-pair multiplexing receiver 400 provides, but is not limited to, accepting multiple ATM cell substreams from different DSL PHYs and recombining the ATM cells from the different ATM cell substreams to recreate the original ATM stream, which is passed to the ATM layer. In particular, and as illustrated in Fig. 6, a plurality of ATM substreams are received by the multi-pair multiplexing receiver 400 and recombined into the original ATM stream. Specifically, as in the multi-pair multiplexing transmitter, the recombining of cells from the DSL PHYs depends on the data rates of the individual PHY connections. As in the embodiment discussed in relation to Fig. 4, where all DSL PHYs had an equal data rate, the multi-pair multiplexing receiver 400 can perform the inverse of the transmitting multiplexer function and reconstruct the original ATM stream by taking one cell from each ATM substream and combining them in the appropriate order, as illustrated in Fig. 7.

| {0044} {0045} | Similarly, as illustrated in relation to the multi-pair multiplexing transmitter 300 illustrated in Fig. 5, where the DSL PHYs had an unequal data rate, if different ratios of data rates are used a variable number of cells will be taken from each ATM substream to reconstruct the original ATM stream in the multi-pair multiplexing receiver 400 as illustrated in Fig. 8.

| {0045} {0046} | Furthermore, in addition to the changes in data rate that are possible on the DSL PHYs, ATM cells transported over a DSL PHY can have different end-to-end delay (latency) based on several parameters. This potential latency difference between bonded PHYs places implementation requirements on the multi-pair multiplexer. In particular, the multi-pair multiplexer receiver must be able to reconstruct the ATM stream even if the ATM cells are not being received in the same order as they were transmitted.

| {0046} {0047} | For example, some of the exemplary reasons for having different delays over different DSL PHYs include, but are not limited, configuration latency which is based on the configuration of the DSL transmission parameters. Specifically, these parameters include the data rate, coding parameters, such as the

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coding method, codeword size, interleaving parameters, framing parameters, or the like.

{0047}{0048} ATM-TC latency is based on cell rate decoupling in the ATM-TC. Specifically, the ATM-TC block in ADSL transceivers performs cell rate decoupling by inserting idle cells according to the ITU Standard I.432, incorporated herein by reference in its entirety. This means that depending on the ATU timing and the state of the ATU buffers, an ATM cell that is sent over a DSL PHY will experience non-constant end-to-end delay (latency) through the PHY.

{0048}{0049} Wire latency is based on differences in the twisted wire pairs. Specifically, the DSL electrical signals can experience different delays based on the difference in length of the wire, the gauge of the wire, the number bridged taps, or the like.

{0049}{0050} Design latency is based on differences in the DSL PHY design. Specifically, the latency of the PHY can also depend on the design chosen by the manufacturer.

{0050}{0051} Thus, as result of the different latencies in the PHYs, it is possible that an ATM cell that was sent over a DSL PHY may be received at the multi-pair multiplexing receiver after an ATM cell that was sent out later on a different DSL PHY.

{0054}{0052} Fig. 9 illustrates an example of variable delay based on the embodiment discussed in relation to Fig. 4. Therefore, the exemplary multi-pair multiplexing receiver 500 should be able to accommodate at least these types of variations in delay. An exemplary method for dealing with the issue of delay is to have cell buffers (not shown) in the multi-pair multiplexing receiver 500 that can provide the ability to compensate for the variations in delay. As example, if there is a cell buffer that can hold several ATM cells on each input ATM substream path, the

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multi-pair multiplexing receiver 500 can simply wait until, for example, cell number 1 comes in path number one, while path number two will buffer cell number 2 and wait for cell number 1 to be received. This method requires a cell buffer on each ATM substream path at the input of the multi-pair multiplexing receiver 500. The size of the cell buffer can be determined by, for example, the maximum difference in latency between the “bonded” PHYs. As an alternative, the buffer can be based on one large buffer with multiple pointers without effecting the operation of the system.

[0052][0053] Another effective method of reducing the difference in latency between DSL PHYs is mandate that all DSL PHYs are configured with transmission parameters in order to provide the same configuration latency. An exemplary method of accomplishing the same configuration latency is by configuring the exact same data rate, coding parameters, interleaving parameters, etc. on all DSL PHYs. Alternatively, different PHYs can have, for example, different data rates but use the appropriate coding or interleaving parameters to have the same latency on all the bonded PHYs.

[0053][0054] As an example, for Reed Solomon coding and interleaving functions as defined in ADSL standards G.992.1 and G.992.3, incorporated herein by reference in their entirety, the latency due to these functions is defined as:

$$\text{Latency} = N*D/R,$$

where N is the number of bits in a codeword, D is the interleaver depth in codewords and R is the data in bits per second.

[0054][0055] For example if N=1600 bits, i.e., 200 bytes, D=64 codewords and R=6400000 bps then:

$$\text{Latency} = 1600*64/640000 = 0.016 \text{ seconds.}$$

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| {0055}{0056} Therefore if, for example, two PHYs have different data rates, R1 and R2 then, in order to bond these PHYs together and have the same configuration latency set:

$$N1*D1/R1 = N2*D2/R2,$$

where N1 and N2 are the bits in a codeword for each PHY and D1 and D2 are the interleaver depths for each PHY.

| {0056}{0057} This can also be rewritten as:

$$N1*D1 = (R1/R2)*N2*D2.$$

Thus, in general, the N1, D1, N2 and D2 parameters must be chosen to satisfy the above equations and this can be accomplished in several ways.

| {0057}{0058} For example, if the configuration latency is specified as 0.016 seconds, and R1=6400000 bps and R2=1600000 then, as described in the example above, N1 and D1 can be configured as N1=1600 and D1=64. Therefore:

$$N2*D2 = (R2/R1)*D1*N1 = (1600000/6400000)*1600*64 = 1600*64/4.$$

Therefore, for example, N2 and D2 can be configured as (N2=1600, D2=16) or (N2=400, D2=64) or (N2=800, D2=32), etc.

| {0058}{0059} Obviously the same methods can be applied to more than 2 PHYs with different data rates.

| {0059}{0060} The ATM-TC receiver in ADSL systems is specified to discard ATM cells that are received with an incorrect cyclic redundancy check, e.g., (HEC). This

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means that if there are bit errors as the result of transmission over the ADSL channel, ATM cells will be discarded by the ATM-TC and not sent to the multi-pair multiplexing receiver. As a result of this type of error condition, ATM cells may be received out of order in the multi-pair multiplexing receiver.

| {0060}|{0061}| Fig. 10 illustrates an exemplary multi-pair multiplexing receiver 500 with a single ATM cell lost due to PHY channel errors using the exemplary embodiment discussed in relation to Fig. 4. In Fig. 10, ATM cell number 5 was discarded by the second DSL PHY 510 due to, for example, a HEC error. Therefore, if the multi-pair multiplexing receiver 500 is not aware of this error, the ATM cells stream can not be reconstructed appropriately.

| {0064}|{0062}| The exemplary systems and methods of this invention utilize a multi-pair cell counter to operate in the condition where the ATM cells are discarded by DSL PHY when, for example, HEC errors occur. The multi-pair multiplexing transmitter can embed the multi-pair cell counter in the header of each ATM cell after receiving the ATM cell from the ATM layer. At the receiver, the multi-pair multiplexing receiver reads the multi-pair cell counter and removes it from the header of the ATM cell prior to sending the ATM cell to the ATM layer. The multi-pair cell counter is a value that indicates the position of a particular ATM cell in the ATM cell stream.

| {0062}|{0063}| In its simplest form, the multi-pair cell counter can be a modulo L counter that starts at, for example, zero and increments by one for each consecutive ATM cell up to a value L-1. For example, if L equals 256, the value of the multi-pair cell counter could start at zero and increment by one up to a value of 255. After 255, the multi-pair counter could be started at zero again, and so on.

| {0063}|{0064}| As previously discussed, the multi-pair cell counter can be embedded in the ATM cell header of all the ATM cells in the ATM stream. Fig. 11 illustrates the multi-pair multiplexing transmitter 400 as discussed in relation to the example

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illustrated in Fig. 4, with L equal to 4 and the multi-pair cell counter specified inside the ATM cell header. At the receiver, the multi-pair cell counter is read by the multi-pair multiplexing receiver and removed from the ATM cell header. The multi-pair multiplexing receiver uses the multi-pair cell counter to properly recombine the ATM cells to reconstruct the ATM stream. Therefore, as in the example above, where a cell was discarded by the DSL PHY, the multi-pair multiplexing receiver would be able to determine this error and the ATM cell(s) placed in the appropriate order.

~~[0064][0065]~~ Fig. 12 illustrates an example where the 5th ATM cell in the ATM stream was discarded by the PHY. The 5th ATM cell in the exemplary ATM stream has a multi-pair cell counter number equal to 0 and was sent on the second ATU. The exemplary multi-pair multiplexing receiver 500 can check the multi-pair cell count value of the ATU's ATM cell before inserting the cell back into the ATM stream. In this manner, when the multi-pair multiplexing receiver checks the ATM cell counter from the second ATU and reads a multi-pair cell count 3 instead of zero, the multi-pair multiplexing receiver can determine that the ATM cell with the multi-pair cell counter equal to 0 was discarded by the second ATU PHY. In this case, multi-pair multiplexing receiver will not take a cell from the ATU-2 ATM substream. Instead, the multi-pair multiplexing receiver will move to the next ATU in order to check the multi-pair cell count value, and insert the ATM cell back into the ATM stream if the multi-pair cell count is correct, and continue. Therefore, as a result of using the multi-pair cell counter, the multi-pair multiplexing receiver can properly reconstruct the original ATM cell stream even in the presence of ATM cell lost.

~~[0065][0066]~~ The exemplary main multi-pair cell parameter is the value of L . The appropriate value of L depends on the number of bonded PHYs (N) and the maximum number (M) of consecutive ATM cells that may be discarded by the PHY. The design constraint on L is that it must be large enough so that the multi-pair multiplexing receiver can still detect cell lost even when the maximum number of consecutive ATM cells are discarded by a PHY. This places the constraint that $L > N * M$. For

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example, if there are $N=4$ bonded PHYs, and the maximum number of consecutive ATM cells that may be discarded by the PHY is $M=50$, then $L>200$. If, for example L is chosen to be equal to 256, then even when 50 consecutive ATM cells are lost, the multi-pair multiplexing receiver can accurately detect the error event.

{0066}{0067} There are several exemplary methods to embedding the multi-pair cell counter into the ATM cell header including, but not limited to, using the GFC field in the UNI ATM header. The GFC field is currently not used and is typically set to zero. The GFC field is a four bit field therefore the maximum value of L is 16. This could pose an issue when the channel has, for example, impulse noise and the PHY data rate is high resulting in cases where multiple ATM cells are often discarded by the PHY.

{0067}{0068} Therefore, as an alternative, bits in the VPI/VCI field can be used. The VPI field occupies 8 bits in the UNI header and identifies the route taken by the ATM cell. The VCI field occupies 16 bits in the UNI header and it identifies the circuit or connection number on the path. In order to use the VPI/VCI field for the multi-pair cell counter, the multi-pair multiplexing transmitter overwrites bits in the VPI/VCI field with the multi-pair cell counter value on a cell by cell basis. At the receiver, the multi-pair multiplexing receiver reads the multi-pair cell counter value and resets and overwrites the VPI/VCI back to the original value.

{0068}{0069} This method requires the multi-pair multiplexing receiver to have knowledge of the overwritten VPI/VCI bits. As an example, this can be accomplished by communicating the VPI/VCI fields of the ATM stream during initialization/configuration of the DSL connection or during configuration or re-configuration of the ATM connection. Since the VPI/VCI field has 24 bits, the L value for the multi-pair cell counter can be set to a very large number.

{0069}{0070} One exemplary method for embedding the multi-pair cell counter in the VPI/VCI field is to construct a table of all, or a portion of, possible VPI/VCI values that may be transported by the bonded DSL PHYs. This VPI/VCI table can,

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for example, be stored in the multi-pair multiplexing transmitters and receivers for all PHYs. The table maps a VPI/VCI value to a table index value that is also stored in the multi-pair multiplexing transmitters and receivers for all PHYs. If there are K VPI/VCI values being transported over the bonded DSL PHYs, the VPI/VCI value could be mapped to a number from zero to K-1. At the multi-pair multiplexing transmitter, the VPI/VCI value in the ATM header is replaced with the table index value. Since there are limited numbers of VPI/VCI going to a single subscriber, the table index value can utilize only a fraction of the 24 bits available in the VPI/VCI field. Therefore, the multi-pair multiplexing transmitter can use the remaining VPI/VCI bits to transport, for example, the multi-pair cell counter.

{0070}{0071} At the receiver, the multi-pair multiplexing receiver is multi-pair cell counter that reconstructs the ATM stream as discussed above. Additionally, the multi-pair multiplexing receiver can read the table index value in the ATM header and write the VPI/VCI value corresponding to the table index value as stored in the VPI/VCI table back into the VPI/VCI header field.

{0071}{0072} As a simple example, where only one VPI/VCI is being sent over the bonded DSL connection, the VPI/VCI table will have only one value. Therefore, in this case, it is not necessary to insert the table index value at the transmitter. The transmitter may use the bits in the VPI/VCI field for the multi-pair cell counter. At the receiver, the multi-pair cell counter is read and used to reconstruct the ATM stream. Since only one VPI/VCI value is being used, the receiver can reset the VPI/VCI field to the appropriate value prior to sending the ATM stream into the ATM layer. This approach can work, for example, with many consumer based employments of a DSL, since in most cases a single VPI/VCI is used.

{0072}{0073} As an alternative, consider a four VPI/VCI situation.

VPI/VCI Value	Table Index Value (TIV)
Va (24 bit value)	0
Vb (24 bit value)	1

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Vc (24 bit value)	2
Vd (24 bit value)	3

Table 1: VPI/VCI Table

¶ [0073][0074] Table 1 contains an exemplary VPI/VCI table with four VPI/VCI addresses. Additionally, for the purpose of this example, the multi-pair cell counter is specified to be an eight bit counter, i.e., a modulo 255 counter.

¶ [0074][0075] Fig. 13 illustrates the format for the standard five bit ATM UNI header. The VPI/VCI values in Table 1 corresponds to the 24 bit VPI/VCI values in the UNI ATM header.

¶ [0075][0076] Fig. 14 illustrates an exemplary format of the ATM header after the multi-pair multiplexing transmitter has replace the VPI/VCI values with the table index value and then embedded the multi-pair cell counter in the VPI/VCI field. The first two bits the VPI/VCI field are used to transport the table index value (TIV) and the next eight bits are used to transport the multi-pair cell counter. The remaining bits can be reserved and can be used, for example, by the multi-pair multiplexing blocks for other purposes, such as the transportation of messages between the multi-pair multiplexing blocks, or the like.

¶ [0076][0077] At the receiver, the multi-pair multiplexing receiver reads the multi-pair cell counter value from the header in order to properly reconstruct the ATM stream. The multi-pair multiplexing receiver also reads the TIV in the ATM header and writes the VPI/VCI corresponding to the table index value as stored in the VPI/VCI table back into the VPI/VCI header field. As a result, at the output of the multi-pair multiplexing receiver, the ATM header can be completely reconstructed into the standard UNI format comprising the original data contents.

¶ [0077][0078] In this illustrative example, there were four VPI/VCI addresses being used in cells being transported over the bonded ADSL system. However, in many deployments, the VP is determined in the DSLAM, which means that the VPI field is

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the same for all packets. Therefore, in the case of terminating the VP and the DSLAM, the VP field could, for example, be used in transporting the TIV.

[0078][0079] Fig. 15 illustrates an exemplary method of transporting ATM over DSL. In particular control begins in step S100 and continues to step S110. In step S110 the cell distributions are determined, for example, based on differing data rates between the DSL PHYs, or the like. Next, in step S120 the cells from the ATM stream are assigned based on the determined cell distribution to the appropriate ATM TC cell stream. Then, in step S130, the cells are transmitted to a receiver. Control then continues to step S140.

[0079][0080] In step S140, a receiver receives the cells. Next, in step S150, the ATM substreams are combined to reconstruct the ATM stream. In particular, in step S152, a determination is made whether there is a difference in latency between the DSL lines. If there are differential latency problems, control continues to step S154 where the differential latency is compensated for by, for example, buffering, or the like. Otherwise, control jumps to step S156.

[0081] In step S156, a determination is made whether other errors are present in one or more of the substreams. If other errors, such as dropped cells, channel bit errors, or the like are present, control continues to step S158 where the other errors are compensated for. Otherwise, control jumps to step S160 where the control sequence ends.

[0082] Fig. 16 is a flowchart illustrating an exemplary method for reducing latency between DSL PHYs. Control begins in step S200 and continues to Step S210. In Step S220, and as discussed, another effective method of reducing the difference in latency between DSL PHYs is mandate that all DSL PHYs are configured with transmission parameters in order to provide the same configuration latency. An exemplary method of accomplishing the same configuration latency is by configuring the exact same data rate, coding parameters, interleaving parameters, etc. on all DSL

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PHYs. Alternatively, different PHYs can have, for example, different data rates but use the appropriate coding or interleaving parameters to have the same latency on all the bonded PHYs.

[0083] One exemplary aspect combines multiple DSL PHY's, i.e., multiple twisted wire pairs, to, for example, generate a high data rate connection for the transport of an ATM cell stream between the service provider and, for example, a DSL subscriber. The ATM cell stream may contain one or more payloads where each payload is channelized within the ATM data stream using different virtual paths (VP) and/or virtual channels (VC). At a transmitter, the ATM cell stream received from the ATM layer is distributed on a cell-by-cell bases across the multiple DSL PHY's. At the receiver, the cells from each DSL PHY are re-combined in the appropriate order to recreate the original ATM cell stream, which is then passed to the ATM layer.

[0084] In particular, the exemplary multi-pair multiplexing transmitter illustrated in Fig. 3 provides, but not limited to, accepting a single ATM stream 310 from the ATM layer and distributing the cells among N ATM substreams 320, where $N \geq 2$. Furthermore, the multi-pair multiplexing transmitter 300 maps each ATM cell substream to a different DSL connection and provides as output these ATM cell substreams to the appropriate ADSL PHY (ATUx). For the exemplary multi-pair multiplexing transmitter 300 illustrated in Fig. 3, the cells from the ATM stream 310 are distributed amongst the ATM substreams 320 based on the data rate of each DSL PHY.

[0085] The configuration of the multi-pair multiplexing transmitter 300 can be varied to, for example, provide an equal or unequal data rate on the DSL PHYs. Fig. 4 illustrates an exemplary embodiment where an equal data rate is applied to all of the DSL PHYs. In particular, if the data rate on all of the DSL PHYs is the same, then an equal number of ATM cells will be transported over every PHY connection. In this case, the multi-pair multiplexing transmitter 300 sends the first ATM cell to ATU1 330, the second ATM cell to ATU2 340, the third ATM cell to ATU3 350, and so on.

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For the multi-pair multiplexing transmitter 300 illustrated in Fig. 4, N=3 and an equal data rate on all DSL PHYs is illustrated, therefore the input ATM cells from the ATM stream 310, as discussed above, are distributed equally and sequentially among the DSL PHYs.

[0086] In Step S230, an exemplary multi-pair multiplexing receiver 400 provides, but is not limited to, accepting multiple ATM cell substreams from different DSL PHYs and recombining the ATM cells from the different ATM cell substreams to recreate the original ATM stream, which is passed to the ATM layer. In particular, a plurality of ATM substreams are received by the multi-pair multiplexing receiver 400 and recombined into the original ATM stream. Specifically, as in the multi-pair multiplexing transmitter, the recombining of cells from the DSL PHYs depends on the data rates of the individual PHY connections. As in the embodiment discussed in relation to Fig. 4, where all DSL PHYs had an equal data rate, the multi-pair multiplexing receiver 400 can perform the inverse of the transmitting multiplexer function and reconstruct the original ATM stream by taking one cell from each ATM substream and combining them in the appropriate order, as illustrated in Fig. 7.

[0080][0087] Similarly, as illustrated in relation to the multi-pair multiplexing transmitter 300 illustrated in Fig. 5, where the DSL PHYs had an unequal data rate, if different ratios of data rates are used a variable number of cells will be taken from each ATM substream to reconstruct the original ATM stream in the multi-pair multiplexing receiver 400 as illustrated in Fig. 8. Control then continues to step S240 where the control sequence ends.

[0084][0088] The above-described ATM over DSL system can be implemented on a telecommunications device, such a modem, a DSL modem, an ADSL modem, a multicarrier transceiver, a VDSL modem, or the like, or on a separate programmed general purpose computer having a communications device. Additionally, the systems and methods of this invention can be implemented on a special purpose computer, a programmed microprocessor or microcontroller and peripheral integrated

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circuit element(s), an ASIC or other integrated circuit, a digital signal processor, a hard-wired electronic or logic circuit such as discrete element circuit, a programmable logic device such as PLD, PLA, FPGA, PAL, modem, transmitter/receiver, or the like. In general, any device capable of implementing a state machine that is in turn capable of implementing the flowchart illustrated herein can be used to implement the various ATM over DSL methods according to this invention.

{0083}{0089L} Furthermore, the disclosed methods may be readily implemented in software using object or object-oriented software development environments that provide portable source code that can be used on a variety of computer or workstation platforms. Alternatively, the disclosed ATM over DSL system may be implemented partially or fully in hardware using standard logic circuits or VLSI design. Whether software or hardware is used to implement the systems in accordance with this invention is dependent on the speed and/or efficiency requirements of the system, the particular function, and the particular software or hardware systems or microprocessor or microcomputer systems being utilized. The ATM over DSL systems and methods illustrated herein however can be readily implemented in hardware and/or software using any known or later developed systems or structures, devices and/or software by those of ordinary skill in the applicable art from the functional description provided herein and with a general basic knowledge of the computer and telecommunications arts.

{0083}{0090L} Moreover, the disclosed methods may be readily implemented in software executed on programmed general purpose computer, a special purpose computer, a microprocessor, or the like. In these instances, the systems and methods of this invention can be implemented as program embedded on personal computer such as JAVA® or CGI script, as a resource residing on a server or graphics workstation, as a routine embedded in a dedicated ATM over DSL system, or the like. The ATM over DSL system can also be implemented by physically incorporating the

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system and method into a software and/or hardware system, such as the hardware and software systems of a communications transceiver.

{0084}{0091} It is, therefore, apparent that there has been provided, in accordance with the present invention, systems and methods for ATM over DSL. While this invention has been described in conjunction with a number of embodiments, it is evident that many alternatives, modifications and variations would be or are apparent to those of ordinary skill in the applicable arts. Accordingly, it is intended to embrace all such alternatives, modifications, equivalents and variations that are within the spirit and scope of this invention.

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ABSTRACT

At a transmitter, an ATM cell stream is received from the ATM layer and is distributed on a cell-by-cell bases across multiple DSL PHY's. At the receiver, the cells from each DSL PHY are re-combined in the appropriate order to recreate the original ATM cell stream, which is then passed to the ATM layer.

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SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL

RELATED APPLICATION DATA

[0001] This application is a Continuation of U.S. Application No. 12/769,277, filed April 28, 2010, now U.S. Patent No. 7,978,706, which is a Continuation of U.S. Application No. 12/247,741, filed October 8, 2008, now U.S. Patent No. 7,809,028, which is a Continuation of U.S. Application No. 10/264,258, filed October 4, 2002, now U.S. Patent No. 7,453,881, which claims the benefit of and priority under 35 U.S.C. §119(e) to U.S. Patent Application Serial No. 60/327,440, filed October 5, 2001, entitled “Multi-Pair ATM Over DSL,” each of which are incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The systems and methods of this invention generally relate to communication systems. In particular, the systems and methods of this invention relate to asynchronous transfer mode (ATM) over digital subscriber line (DSL).

Description of Related Art

[0003] Fig. 1 illustrates the conventional configuration of a system for transporting ATM over DSL using a single latency ADSL configuration. As of the time of filing, single latency is most common form of ADSL deployment. Further details of this specific architecture can be found in DSL Forum Recommendation TR-042, incorporated herein by reference in its entirety.

[0004] For the system illustrated in Fig. 1, the access node 10 serves as an ATM layer multiplexer/concentrator between the ATM core network 2 and the access network. As described in the above referenced DSL Forum Recommendation, for

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ATM systems, the channelization of different payloads is embedded within the ATM data stream using different virtual paths (VP) and/or virtual channels (VC). In the downstream direction, the VP/VC Mux module 16 and VPI/VCI translation module 14 receive cells from the core network interface element 12 and function to perform cell routing based on a virtual path identifier (VPI) and/or virtual channel identifier (VCI) to the appropriate ATU-C 18. In the upstream direction, the VP/VC Mux module 16 and the VPI/VCI translation module 14 function to combine the cell streams from the ATU-C's 18 into a single ATM cell stream to the core ATM network 2.

[0005] The broadband network termination (B-NT) 100 performs the functions of terminating the ADSL signal entering the user's premises via the twisted pair cable and the ATU-R 22 and provides either the T, S or R interface towards the premises distribution network/ terminal equipment 4. The access ATM module 26 and the VP/VC Mux module 24 perform the ATM layer functions to support the TC layers in the ATU-R. The broadband network termination 100 may also contain VPI/VCI translation functions to support multiplex/demultiplex of VC's between the ATU-R 22 and the premise distribution network/terminal equipment 4 on a VPI and /or VCI bases. The broadband network termination 100 may also comprise a PDN/TE interface element 28 and SAR module 30 the functions of which are well known and will be omitted for sake of clarity.

SUMMARY OF THE INVENTION

[0006] The exemplary systems and methods of this invention combine multiple DSL PHY's, i.e., multiple twisted wire pairs, to, for example, generate a high data rate connection for the transport of an ATM cell stream between the service provider and, for example, a DSL subscriber. The ATM cell stream may contain one or more payloads where each payload is channelized within the ATM data stream using

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different virtual paths (VP) and/or virtual channels (VC). At a transmitter, the ATM cell stream received from the ATM layer is distributed on a cell-by-cell bases across the multiple DSL PHY's. At the receiver, the cells from each DSL PHY are recombined in the appropriate order to recreate the original ATM cell stream, which is then passed to the ATM layer.

[0007] Accordingly, aspects of the invention relate to ATM communications.

[0008] Additional aspects of the invention relate to transporting ATM over DSL, and more particularly over ADSL.

[0009] Additional aspects of the invention also relate to distributing ATM cells from a single ATM cell stream across multiple twisted wire pairs.

[0010] Further aspects of the invention relate to distributing ATM cells from a single ATM cell stream across multiple DSL communication links.

[0011] Further aspects of the invention relate to varying data rates over the multiple twisted wire pairs over which distributed ATM cells are transported.

[0012] These and other features and advantages of this invention are described in, or apparent from, the following detailed description of the embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The embodiments of the invention will be described in detail, with reference to the following figures, wherein:

[0014] Fig. 1 is a functional block diagram illustrating a conventional ATM over ADSL system;

[0015] Fig. 2 is a functional block diagram illustrating an exemplary system for

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transporting ATM over ADSL according to this invention;

[0016] Fig. 3 illustrates an exemplary functional block diagram of the multi-pair multiplexing transmitter according to this invention;

[0017] Fig. 4 illustrates a functional block diagram of a second exemplary multi-pair multiplexing transmitter according to this invention;

[0018] Fig. 5 illustrates a functional block diagram of a third exemplary embodiment of the multi-pair multiplexing transmitter according to this invention;

[0019] Fig. 6 illustrates a functional block diagram of an exemplary multi-pair multiplexing receiver according to this invention;

[0020] Fig. 7 illustrates a functional block diagram of a second exemplary multi-pair multiplexing receiver according to this invention;

[0021] Fig. 8 illustrates a functional block diagram of a third exemplary multi-pair multiplexing receiver according to this invention;

[0022] Fig. 9 is a functional block diagram illustrating a fourth exemplary multi-pair multiplexing receiver according to this invention;

[0023] Fig. 10 illustrates a functional block diagram of a fifth exemplary multi-pair multiplexing receiver according to this invention;

[0024] Fig. 11 illustrates a functional block diagram of a fourth exemplary multi-pair multiplexing transmitter according to this invention;

[0025] Fig. 12 is a functional block diagram illustrating a sixth exemplary multi-pair multiplexing receiver according to this invention;

[0026] Fig. 13 illustrates a standard five byte ATM UNI header;

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[0027] Fig. 14 illustrates an exemplary modified ATM header according to this invention; and

[0028] Fig. 15 is a flowchart outlining an exemplary embodiment of a method for combining multiple DSL PHYs to transport an ATM cell stream between a service provider and a subscriber.

[0029] Fig. 16 is a flowchart illustrating an exemplary method for reducing latency between DSL PHYs.

DETAILED DESCRIPTION OF THE INVENTION

[0030] The exemplary systems and the methods of this invention will be described in relation to digital subscriber line communications and more particularly to asymmetric digital subscriber line communications. However, to avoid unnecessarily obscuring the present invention, the following description omits well-known structures and devices that may be shown in block diagram form or otherwise summarized. For the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It should be appreciated however that the present invention may be practiced in variety of ways beyond the specific details set forth herein. For example, the systems and methods of this invention can generally be applied to any type of communications system including wireless communication systems, such as wireless LANs, power line communications, or any other systems or combination systems that use ATM.

[0031] Furthermore, while the exemplary embodiments illustrated herein show the various components of the communication system collocated, it is to be appreciated that the various components of the system can be located at distant portions of distributed network, such as a telecommunications network and/or the Internet, or within a dedicated ATM over DSL system. Thus, it should be appreciated

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that the components of the communication system can be combined into one or more devices or collocated on a particular node of a distributed network, such as a telecommunications network. It will be appreciated from the following description, and for reasons of computational efficiency, that the components of the communication system can be arranged at any location within a distributed network without affecting the operation of the system.

[0032] Furthermore, it should be appreciated that the various links connecting the elements can be wired or wireless links, or a combination thereof or any other known or later developed element(s) that is capable of supplying and/or communicating data to and from the connected elements. Additionally, the term module as used herein can refer to any known or later developed hardware, software, or combination of hardware and software that is capable of performing the functionality associated with that element.

[0033] Additionally, although this invention will be described in relation to ATM systems, the systems and methods of this invention can be applied to any transport protocol that uses cells or packets for transmitting information. Therefore, for example, the same methods can be used for the bonding of PHYs that transport Ethernet or IP packets. Furthermore, although this invention will be described in relation to ATM transported over DSL PHYs, other PHYs, such as cable, voice band modems, ATM-25, and the like, can also be used.

[0034] Fig. 2 illustrates an exemplary multi-pair ATM over DSL system. In particular, the system comprises an access node 100, a broadband network termination 200, an ATM core network 2 and premise distribution network/terminal equipment 4. The access node 100 further comprises a core network interface element 110, a VPI/VCI translation module 120, a VP/VC Mux module 130, an ATU-C multi-pair multiplexer 140 and a plurality of ATM TC ATU-C modules 150. The broadband network termination 200 further comprises a plurality of ATU-R ATM TCs 210, an ATU-R multi-pair multiplexer 220, a VP/VC Mux module 230, an

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access ATM module 240, and a PDN/TE interface module 250. Furthermore, the system comprises a SAR and PDN function module 260, wherein the functions of like components have been discussed in relation to Fig. 1.

[0035] The exemplary system illustrated in Fig. 2 distributes ATM cells from a single ATM cell stream across multiple ADSL PHY links, i.e., multiple twisted wire pairs (1 to n). The ATM cell stream, also referred to as the ATM stream, may comprise one or more payloads where each payload is channelized within the ATM stream using different virtual paths (VP) and/or virtual channels (VC). This can effectively create, for example, a high data rate ATM connection between a service provider and an ADSL subscriber.

[0036] In accordance with an exemplary embodiment of this invention, the ATU-C multi-pair multiplexer 140 is inserted between the VP/VC multiplexer 130 and the ATU-C's 150 at the V-C interface in the access node 100. Additionally, the ATU-R multi-pair multiplexer 220 is added to the broadband network termination 200 at the T-R interface. Both of these multi-pair multiplexers have transmitter and receiver sections (not shown) whose operations are comparable. The multi-pair multiplexer transmitter section performs the task of distributing cells from the ATM stream among multiple ATM cell substreams. Each ATM cell substream, also referred to as an ATM substream, is forwarded a different ATU. The multi-pair multiplexer receiver section performs the task of recombining the ATM substreams to regain the original ATM stream.

[0037] In the exemplary system illustrated in Fig. 2, two ADSL PHYs 160 and 170 are “bonded” together to transport a single ATM cell stream. However, it should be appreciated, that the number of ADSL PHYs “bonded” together can be easily expanded to any number ($N \geq 2$) of ADSL PHYs thereby, for example, enabling higher ATM data rates. In addition to the two ADSL PHYs 160 and 170 that are bonded together, it should further be appreciated that in some instances in the same access node 100, other ADSL PHYs may be operating in the traditional way. Obviously, the

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ADSL PHYs operating the traditional way do not need to be connected to the multi-pair multiplexer 140. Thus, in general, it should be appreciated that any combination of “bonded” and unbonded, i.e. traditional, ADSL PHY’s, may be configured between the access node 100 and the broadband network determination 200. Furthermore, it should be appreciated that all of the ADSL PHYs can be bonded together.

[0038] In many ADSL systems, the logical interface between the ATM layer and the PHY is based on UTOPIA Level 2 with a cell level handshake. This same UTOPIA Level 2 logical interface can also be used between the multi-pair multiplexer and the ATM layer and also between the multi-pair multiplexer and the PHY in the access node 100 and the broadband network termination 200. Although, the above example and the remainder of this discussion will be directed toward the multi-pair multiplexer functions using a ADSL PHY, any version of DSL that has an ATM-TC, e.g., VDSL, SHDSL, or the like, may be used instead of, or conjunction with, the ADSL PHY.

[0039] Fig. 3 illustrates an exemplary multi-pair multiplexing transmitter according to this invention. The ATU-C and ATU-R multi-pair multiplexer box provide the same basic transmitter and receiver functions and thus can be summarized as one unit.

[0040] In particular, the exemplary multi-pair multiplexing transmitter 300 illustrated in Fig. 3 provides, but not limited to, accepting a single ATM stream 310 from the ATM layer and distributing the cells among N ATM substreams 320, where $N \geq 2$. Furthermore, the multi-pair multiplexing transmitter 300 maps each ATM cell substream to a different DSL connection and provides as output these ATM cell substreams to the appropriate ADSL PHY (ATUx). For the exemplary multi-pair multiplexing transmitter 300 illustrated in Fig. 3, the cells from the ATM stream 310 are distributed amongst the ATM substreams 320 based on the data rate of each DSL PHY.

[0041] The configuration of the multi-pair multiplexing transmitter 300 can be

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varied to, for example, provide an equal or unequal data rate on the DSL PHYs. Fig. 4 illustrates an exemplary embodiment where an equal data rate is applied to all of the DSL PHYs. In particular, if the data rate on all of the DSL PHYs is the same, then an equal number of ATM cells will be transported over every PHY connection. In this case, the multi-pair multiplexing transmitter 300 sends the first ATM cell to ATU1 330, the second ATM cell to ATU2 340, the third ATM cell to ATU3 350, and so on. For the multi-pair multiplexing transmitter 300 illustrated in Fig. 4, $N=3$ and an equal data rate on all DSL PHYs is illustrated, therefore the input ATM cells from the ATM stream 310, as discussed above, are distributed equally and sequentially among the DSL PHYs.

[0042] For the multi-pair multiplexing transmitter 300 illustrated in Fig. 5, an unequal data rate is transported on the DSL PHYs. In particular, if a data rate on all the DSL PHYs is not equal, the ATM cells can be forward to the DSL PHYs, at, for example, a ratio that matches the ratios of the available PHY data rates. If, for example, $N=2$, as illustrated in Fig. 5, and the data rate of the first DSL PHY 360 is two times the data rate of the second PHY 370, then the multi-pair multiplexer 300 would send 2 ATM cells to the first DSL PHY, i.e., cells 1 and 2, and then send 1 ATM cell to the second DSL PHY, i.e., cell 3. However, in general, this basic concept can be expanded at least to include the situation where $N>2$ and to non-integer data rate ratios.

[0043] For example, in a two modem environment where there is a “high-speed” and a “low-speed” implementation, an exemplary ratio of $N:1$ where $N=2$ to 8 can be specified. This means that the “high-speed” modem will have eight times the cells as the “low-speed” modem. In this exemplary configuration, there are eight cells of receiver FIFO meaning that the entire “high-speed” receiver could be emptied before needing to service the “low-speed” receiver.

[0044] Fig. 6 illustrates an exemplary multi-pair multiplexing receiver 400. The exemplary multi-pair multiplexing receiver 400 provides, but is not limited to,

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accepting multiple ATM cell substreams from different DSL PHYs and recombining the ATM cells from the different ATM cell substreams to recreate the original ATM stream, which is passed to the ATM layer. In particular, and as illustrated in Fig. 6, a plurality of ATM substreams are received by the multi-pair multiplexing receiver 400 and recombined into the original ATM stream. Specifically, as in the multi-pair multiplexing transmitter, the recombining of cells from the DSL PHYs depends on the data rates of the individual PHY connections. As in the embodiment discussed in relation to Fig. 4, where all DSL PHYs had an equal data rate, the multi-pair multiplexing receiver 400 can perform the inverse of the transmitting multiplexer function and reconstruct the original ATM stream by taking one cell from each ATM substream and combining them in the appropriate order, as illustrated in Fig. 7.

[0045] Similarly, as illustrated in relation to the multi-pair multiplexing transmitter 300 illustrated in Fig. 5, where the DSL PHYs had an unequal data rate, if different ratios of data rates are used a variable number of cells will be taken from each ATM substream to reconstruct the original ATM stream in the multi-pair multiplexing receiver 400 as illustrated in Fig. 8.

[0046] Furthermore, in addition to the changes in data rate that are possible on the DSL PHYs, ATM cells transported over a DSL PHY can have different end-to-end delay (latency) based on several parameters. This potential latency difference between bonded PHYs places implementation requirements on the multi-pair multiplexer. In particular, the multi-pair multiplexer receiver must be able to reconstruct the ATM stream even if the ATM cells are not being received in the same order as they were transmitted.

[0047] For example, some of the exemplary reasons for having different delays over different DSL PHYs include, but are not limited, configuration latency which is based on the configuration of the DSL transmission parameters. Specifically, these parameters include the data rate, coding parameters, such as the coding method, codeword size, interleaving parameters, framing parameters, or the like.

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[0048] ATM-TC latency is based on cell rate decoupling in the ATM-TC. Specifically, the ATM-TC block in ADSL transceivers performs cell rate decoupling by inserting idle cells according to the ITU Standard I.432, incorporated herein by reference in its entirety. This means that depending on the ATU timing and the state of the ATU buffers, an ATM cell that is sent over a DSL PHY will experience non-constant end-to-end delay (latency) through the PHY.

[0049] Wire latency is based on differences in the twisted wire pairs. Specifically, the DSL electrical signals can experience different delays based on the difference in length of the wire, the gauge of the wire, the number bridged taps, or the like.

[0050] Design latency is based on differences in the DSL PHY design.

Specifically, the latency of the PHY can also depend on the design chosen by the manufacturer.

[0051] Thus, as result of the different latencies in the PHYs, it is possible that an ATM cell that was sent over a DSL PHY may be received at the multi-pair multiplexing receiver after an ATM cell that was sent out later on a different DSL PHY.

[0052] Fig. 9 illustrates an example of variable delay based on the embodiment discussed in relation to Fig. 4. Therefore, the exemplary multi-pair multiplexing receiver 500 should be able to accommodate at least these types of variations in delay. An exemplary method for dealing with the issue of delay is to have cell buffers (not shown) in the multi-pair multiplexing receiver 500 that can provide the ability to compensate for the variations in delay. As example, if there is a cell buffer that can hold several ATM cells on each input ATM substream path, the multi-pair multiplexing receiver 500 can simply wait until, for example, cell number 1 comes in path number one, while path number two will buffer cell number 2 and wait for cell number 1 to be received. This method requires a cell buffer on each ATM substream

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path at the input of the multi-pair multiplexing receiver 500. The size of the cell buffer can be determined by, for example, the maximum difference in latency between the “bonded” PHYs. As an alternative, the buffer can be based on one large buffer with multiple pointers without effecting the operation of the system.

[0053] Another effective method of reducing the difference in latency between DSL PHYs is mandate that all DSL PHYs are configured with transmission parameters in order to provide the same configuration latency. An exemplary method of accomplishing the same configuration latency is by configuring the exact same data rate, coding parameters, interleaving parameters, etc. on all DSL PHYs. Alternatively, different PHYs can have, for example, different data rates but use the appropriate coding or interleaving parameters to have the same latency on all the bonded PHYs.

[0054] As an example, for Reed Solomon coding and interleaving functions as defined in ADSL standards G.992.1 and G.992.3, incorporated herein by reference in their entirety, the latency due to these functions is defined as:

$$\text{Latency} = N*D/R,$$

where N is the number of bits in a codeword, D is the interleaver depth in codewords and R is the data in bits per second.

[0055] For example if N=1600 bits, i.e., 200 bytes, D=64 codewords and R=6400000 bps then:

$$\text{Latency} = 1600*64/640000 = 0.016 \text{ seconds.}$$

[0056] Therefore if, for example, two PHYs have different data rates, R1 and R2 then, in order to bond these PHYs together and have the same configuration latency set:

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$$N1*D1/R1 = N2*D2/R2,$$

where N1 and N2 are the bits in a codeword for each PHY and D1 and D2 are the interleaver depths for each PHY.

[0057] This can also be rewritten as:

$$N1*D1 = (R1/R2)*N2*D2.$$

Thus, in general, the N1, D1, N2 and D2 parameters must be chosen to satisfy the above equations and this can be accomplished in several ways.

[0058] For example, if the configuration latency is specified as 0.016 seconds, and R1=6400000 bps and R2=1600000 then, as described in the example above, N1 and D1 can be configured as N1=1600 and D1=64. Therefore:

$$N2*D2 = (R2/R1)*D1*N1 = (1600000/6400000)*1600*64 = 1600*64/4.$$

Therefore, for example, N2 and D2 can be configured as (N2=1600, D2=16) or (N2=400, D2=64) or (N2=800, D2=32), etc.

[0059] Obviously the same methods can be applied to more than 2 PHYs with different data rates.

[0060] The ATM-TC receiver in ADSL systems is specified to discard ATM cells that are received with an incorrect cyclic redundancy check, e.g., (HEC). This means that if there are bit errors as the result of transmission over the ADSL channel, ATM cells will be discarded by the ATM-TC and not sent to the multi-pair multiplexing receiver. As a result of this type of error condition, ATM cells may be received out of

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order in the multi-pair multiplexing receiver.

[0061] Fig. 10 illustrates an exemplary multi-pair multiplexing receiver 500 with a single ATM cell lost due to PHY channel errors using the exemplary embodiment discussed in relation to Fig. 4. In Fig. 10, ATM cell number 5 was discarded by the second DSL PHY 510 due to, for example, a HEC error. Therefore, if the multi-pair multiplexing receiver 500 is not aware of this error, the ATM cells stream can not be reconstructed appropriately.

[0062] The exemplary systems and methods of this invention utilize a multi-pair cell counter to operate in the condition where the ATM cells are discarded by DSL PHY when, for example, HEC errors occur. The multi-pair multiplexing transmitter can embed the multi-pair cell counter in the header of each ATM cell after receiving the ATM cell from the ATM layer. At the receiver, the multi-pair multiplexing receiver reads the multi-pair cell counter and removes it from the header of the ATM cell prior to sending the ATM cell to the ATM layer. The multi-pair cell counter is a value that indicates the position of a particular ATM cell in the ATM cell stream.

[0063] In its simplest form, the multi-pair cell counter can be a modulo L counter that starts at, for example, zero and increments by one for each consecutive ATM cell up to a value L-1. For example, if L equals 256, the value of the multi-pair cell counter could start at zero and increment by one up to a value of 255. After 255, the multi-pair counter could be started at zero again, and so on.

[0064] As previously discussed, the multi-pair cell counter can be embedded in the ATM cell header of all the ATM cells in the ATM stream. Fig. 11 illustrates the multi-pair multiplexing transmitter 400 as discussed in relation to the example illustrated in Fig. 4, with L equal to 4 and the multi-pair cell counter specified inside the ATM cell header. At the receiver, the multi-pair cell counter is read by the multi-pair multiplexing receiver and removed from the ATM cell header. The multi-pair multiplexing receiver uses the multi-pair cell counter to properly recombine the ATM

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cells to reconstruct the ATM stream. Therefore, as in the example above, where a cell was discarded by the DSL PHY, the multi-pair multiplexing receiver would be able to determine this error and the ATM cell(s) placed in the appropriate order.

[0065] Fig. 12 illustrates an example where the 5th ATM cell in the ATM stream was discarded by the PHY. The 5th ATM cell in the exemplary ATM stream has a multi-pair cell counter number equal to 0 and was sent on the second ATU. The exemplary multi-pair multiplexing receiver 500 can check the multi-pair cell count value of the ATU's ATM cell before inserting the cell back into the ATM stream. In this manner, when the multi-pair multiplexing receiver checks the ATM cell counter from the second ATU and reads a multi-pair cell count 3 instead of zero, the multi-pair multiplexing receiver can determine that the ATM cell with the multi-pair cell counter equal to 0 was discarded by the second ATU PHY. In this case, multi-pair multiplexing receiver will not take a cell from the ATU-2 ATM substream. Instead, the multi-pair multiplexing receiver will move to the next ATU in order to check the multi-pair cell count value, and insert the ATM cell back into the ATM stream if the multi-pair cell count is correct, and continue. Therefore, as a result of using the multi-pair cell counter, the multi-pair multiplexing receiver can properly reconstruct the original ATM cell stream even in the presence of ATM cell lost.

[0066] The exemplary main multi-pair cell parameter is the value of L. The appropriate value of L depends on the number of bonded PHYs (N) and the maximum number (M) of consecutive ATM cells that may be discarded by the PHY. The design constraint on L is that it must be large enough so that the multi-pair multiplexing receiver can still detect cell lost even when the maximum number of consecutive ATM cells are discarded by a PHY. This places the constraint that $L > N * M$. For example, if there are N=4 bonded PHYs, and the maximum number of consecutive ATM cells that may be discarded by the PHY is M=50, then $L > 200$. If, for example L is chosen to be equal to 256, then even when 50 consecutive ATM cells are lost, the multi-pair multiplexing receiver can accurately detect the error event.

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[0067] There are several exemplary methods to embedding the multi-pair cell counter into the ATM cell header including, but not limited to, using the GFC field in the UNI ATM header. The GFC field is currently not used and is typically set to zero. The GFC field is a four bit field therefore the maximum value of L is 16. This could pose an issue when the channel has, for example, impulse noise and the PHY data rate is high resulting in cases where multiple ATM cells are often discarded by the PHY.

[0068] Therefore, as an alternative, bits in the VPI/VCI field can be used. The VPI field occupies 8 bits in the UNI header and identifies the route taken by the ATM cell. The VCI field occupies 16 bits in the UNI header and it identifies the circuit or connection number on the path. In order use the VPI/VCI field for the multi-pair cell counter, the multi-pair multiplexing transmitter overwrites bits in the VPI/VCI field with the multi-pair cell counter value on a cell by cell bases. At the receiver, the multi-pair multiplexing receiver reads the multi-pair cell counter value and resets and overwrites the VPI/VCI back to the original value.

[0069] This method requires the multi-pair multiplexing receiver to have knowledge of the overwritten VPI/VCI bits. As an example, this can be accomplished by communicating the VPI/VCI fields of the ATM stream during initialization/configuration of the DSL connection or during configuration or re-configuration of the ATM connection. Since the VPI/VCI field has 24 bits, the L value for the multi-pair cell counter can be set to a very large number.

[0070] One exemplary method for embedding the multi-pair cell counter in the VPI/VCI field is to construct a table of all, or a portion of, possible VPI/VCI values that may be transported by the bonded DSL PHYs. This VPI/VCI table can, for example, be stored in the multi-pair multiplexing transmitters and receivers for all PHYs. The table maps a VPI/VCI value to a table index value that is also stored in the multi-pair multiplexing transmitters and receivers for all PHYs. If there are K VPI/VCI values being transported over the bonded DSL PHYs, the VPI/VCI value could be mapped to a number from zero to K-1. At the multi-pair multiplexing

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transmitter, the VPI/VCI value in the ATM header is replaced with the table index value. Since there are limited numbers of VPI/VCI going to a single subscriber, the table index value can utilize only a fraction of the 24 bits available in the VPI/VCI field. Therefore, the multi-pair multiplexing transmitter can use the remaining VPI/VCI bits to transport, for example, the multi-pair cell counter.

[0071] At the receiver, the multi-pair multiplexing receiver is multi-pair cell counter that reconstructs the ATM stream as discussed above. Additionally, the multi-pair multiplexing receiver can read the table index value in the ATM header and write the VPI/VCI value corresponding to the table index value as stored in the VPI/VCI table back into the VPI/VCI header field.

[0072] As a simple example, where only one VPI/VCI is being sent over the bonded DSL connection, the VPI/VCI table will have only one value. Therefore, in this case, it is not necessary to insert the table index value at the transmitter. The transmitter may use the bits in the VPI/VCI field for the multi-pair cell counter. At the receiver, the multi-pair cell counter is read and used to reconstruct the ATM stream. Since only one VPI/VCI value is being used, the receiver can reset the VPI/VCI field to the appropriate value prior to sending the ATM stream into the ATM layer. This approach can work, for example, with many consumer based employments of a DSL, since in most cases a single VPI/VCI is used.

[0073] As an alternative, consider a four VPI/VCI situation.

VPI/VCI Value	Table Index Value (TIV)
Va (24 bit value)	0
Vb (24 bit value)	1
Vc (24 bit value)	2
Vd (24 bit value)	3

Table 1: VPI/VCI Table

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[0074] Table 1 contains an exemplary VPI/VCI table with four VPI/VCI addresses. Additionally, for the purpose of this example, the multi-pair cell counter is specified to be an eight bit counter, i.e., a modulo 255 counter.

[0075] Fig. 13 illustrates the format for the standard five bit ATM UNI header. The VPI/VCI values in Table 1 corresponds to the 24 bit VPI/VCI values in the UNI ATM header.

[0076] Fig. 14 illustrates an exemplary format of the ATM header after the multi-pair multiplexing transmitter has replace the VPI/VCI values with the table index value and then embedded the multi-pair cell counter in the VPI/VCI field. The first two bits the VPI/VCI field are used to transport the table index value (TIV) and the next eight bits are used to transport the multi-pair cell counter. The remaining bits can be reserved and can be used, for example, by the multi-pair multiplexing blocks for other purposes, such as the transportation of messages between the multi-pair multiplexing blocks, or the like.

[0077] At the receiver, the multi-pair multiplexing receiver reads the multi-pair cell counter value from the header in order to properly reconstruct the ATM stream. The multi-pair multiplexing receiver also reads the TIV in the ATM header and writes the VPI/VCI corresponding to the table index value as stored in the VPI/VCI table back into the VPI/VCI header field. As a result, at the output of the multi-pair multiplexing receiver, the ATM header can be completely reconstructed into the standard UNI format comprising the original data contents.

[0078] In this illustrative example, there were four VPI/VCI addresses being used in cells being transported over the bonded ADSL system. However, in many deployments, the VP is determined in the DSLAM, which means that the VPI field is the same for all packets. Therefore, in the case of terminating the VP and the DSLAM, the VP field could, for example, be used in transporting the TIV.

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[0079] Fig. 15 illustrates an exemplary method of transporting ATM over DSL. In particular control begins in step S100 and continues to step S110. In step S110 the cell distributions are determined, for example, based on differing data rates between the DSL PHYs, or the like. Next, in step S120 the cells from the ATM stream are assigned based on the determined cell distribution to the appropriate ATM TC cell stream. Then, in step S130, the cells are transmitted to a receiver. Control then continues to step S140.

[0080] In step S140, a receiver receives the cells. Next, in step S150, the ATM substreams are combined to reconstruct the ATM stream. In particular, in step S152, a determination is made whether there is a difference in latency between the DSL lines. If there are differential latency problems, control continues to step S154 where the differential latency is compensated for by, for example, buffering, or the like. Otherwise, control jumps to step S156.

[0081] In step S156, a determination is made whether other errors are present in one or more of the substreams. If other errors, such as dropped cells, channel bit errors, or the like are present, control continues to step S158 where the other errors are compensated for. Otherwise, control jumps to step S160 where the control sequence ends.

[0082] Fig. 16 is a flowchart illustrating an exemplary method for reducing latency between DSL PHYs. Control begins in step S200 and continues to Step S210. In Step S220, and as discussed, another effective method of reducing the difference in latency between DSL PHYs is mandate that all DSL PHYs are configured with transmission parameters in order to provide the same configuration latency. An exemplary method of accomplishing the same configuration latency is by configuring the exact same data rate, coding parameters, interleaving parameters, etc. on all DSL PHYs. Alternatively, different PHYs can have, for example, different data rates but use the appropriate coding or interleaving parameters to have the same latency on all the bonded PHYs.

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[0083] One exemplary aspect combines multiple DSL PHY's, i.e., multiple twisted wire pairs, to, for example, generate a high data rate connection for the transport of an ATM cell stream between the service provider and, for example, a DSL subscriber. The ATM cell stream may contain one or more payloads where each payload is channelized within the ATM data stream using different virtual paths (VP) and/or virtual channels (VC). At a transmitter, the ATM cell stream received from the ATM layer is distributed on a cell-by-cell bases across the multiple DSL PHY's. At the receiver, the cells from each DSL PHY are re-combined in the appropriate order to recreate the original ATM cell stream, which is then passed to the ATM layer.

[0084] In particular, the exemplary multi-pair multiplexing transmitter illustrated in Fig. 3 provides, but not limited to, accepting a single ATM stream 310 from the ATM layer and distributing the cells among N ATM substreams 320, where $N \geq 2$. Furthermore, the multi-pair multiplexing transmitter 300 maps each ATM cell substream to a different DSL connection and provides as output these ATM cell substreams to the appropriate ADSL PHY (ATUx). For the exemplary multi-pair multiplexing transmitter 300 illustrated in Fig. 3, the cells from the ATM stream 310 are distributed amongst the ATM substreams 320 based on the data rate of each DSL PHY.

[0085] The configuration of the multi-pair multiplexing transmitter 300 can be varied to, for example, provide an equal or unequal data rate on the DSL PHYs. Fig. 4 illustrates an exemplary embodiment where an equal data rate is applied to all of the DSL PHYs. In particular, if the data rate on all of the DSL PHYs is the same, then an equal number of ATM cells will be transported over every PHY connection. In this case, the multi-pair multiplexing transmitter 300 sends the first ATM cell to ATU1 330, the second ATM cell to ATU2 340, the third ATM cell to ATU3 350, and so on. For the multi-pair multiplexing transmitter 300 illustrated in Fig. 4, $N=3$ and an equal data rate on all DSL PHYs is illustrated, therefore the input ATM cells from the ATM stream 310, as discussed above, are distributed equally and sequentially among the

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DSL PHYs.

[0086] In Step S230, an exemplary multi-pair multiplexing receiver 400 provides, but is not limited to, accepting multiple ATM cell substreams from different DSL PHYs and recombining the ATM cells from the different ATM cell substreams to recreate the original ATM stream, which is passed to the ATM layer. In particular, a plurality of ATM substreams are received by the multi-pair multiplexing receiver 400 and recombined into the original ATM stream. Specifically, as in the multi-pair multiplexing transmitter, the recombining of cells from the DSL PHYs depends on the data rates of the individual PHY connections. As in the embodiment discussed in relation to Fig. 4, where all DSL PHYs had an equal data rate, the multi-pair multiplexing receiver 400 can perform the inverse of the transmitting multiplexer function and reconstruct the original ATM stream by taking one cell from each ATM substream and combining them in the appropriate order, as illustrated in Fig. 7.

[0087] Similarly, as illustrated in relation to the multi-pair multiplexing transmitter 300 illustrated in Fig. 5, where the DSL PHYs had an unequal data rate, if different ratios of data rates are used a variable number of cells will be taken from each ATM substream to reconstruct the original ATM stream in the multi-pair multiplexing receiver 400 as illustrated in Fig. 8. Control then continues to step S240 where the control sequence ends.

[0088] The above-described ATM over DSL system can be implemented on a telecommunications device, such a modem, a DSL modem, an ADSL modem, a multicarrier transceiver, a VDSL modem, or the like, or on a separate programmed general purpose computer having a communications device. Additionally, the systems and methods of this invention can be implemented on a special purpose computer, a programmed microprocessor or microcontroller and peripheral integrated circuit element(s), an ASIC or other integrated circuit, a digital signal processor, a hard-wired electronic or logic circuit such as discrete element circuit, a programmable logic device such as PLD, PLA, FPGA, PAL, modem, transmitter/receiver, or the

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like. In general, any device capable of implementing a state machine that is in turn capable of implementing the flowchart illustrated herein can be used to implement the various ATM over DSL methods according to this invention.

[0089] Furthermore, the disclosed methods may be readily implemented in software using object or object-oriented software development environments that provide portable source code that can be used on a variety of computer or workstation platforms. Alternatively, the disclosed ATM over DSL system may be implemented partially or fully in hardware using standard logic circuits or VLSI design. Whether software or hardware is used to implement the systems in accordance with this invention is dependent on the speed and/or efficiency requirements of the system, the particular function, and the particular software or hardware systems or microprocessor or microcomputer systems being utilized. The ATM over DSL systems and methods illustrated herein however can be readily implemented in hardware and/or software using any known or later developed systems or structures, devices and/or software by those of ordinary skill in the applicable art from the functional description provided herein and with a general basic knowledge of the computer and telecommunications arts.

[0090] Moreover, the disclosed methods may be readily implemented in software executed on programmed general purpose computer, a special purpose computer, a microprocessor, or the like. In these instances, the systems and methods of this invention can be implemented as program embedded on personal computer such as JAVA® or CGI script, as a resource residing on a server or graphics workstation, as a routine embedded in a dedicated ATM over DSL system, or the like. The ATM over DSL system can also be implemented by physically incorporating the system and method into a software and/or hardware system, such as the hardware and software systems of a communications transceiver.

[0091] It is, therefore, apparent that there has been provided, in accordance with the present invention, systems and methods for ATM over DSL. While this invention

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has been described in conjunction with a number of embodiments, it is evident that many alternatives, modifications and variations would be or are apparent to those of ordinary skill in the applicable arts. Accordingly, it is intended to embrace all such alternatives, modifications, equivalents and variations that are within the spirit and scope of this invention.

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ABSTRACT

At a transmitter, an ATM cell stream is received from the ATM layer and is distributed on a cell-by-cell bases across multiple DSL PHY's. At the receiver, the cells from each DSL PHY are re-combined in the appropriate order to recreate the original ATM cell stream, which is then passed to the ATM layer.

New Sheet

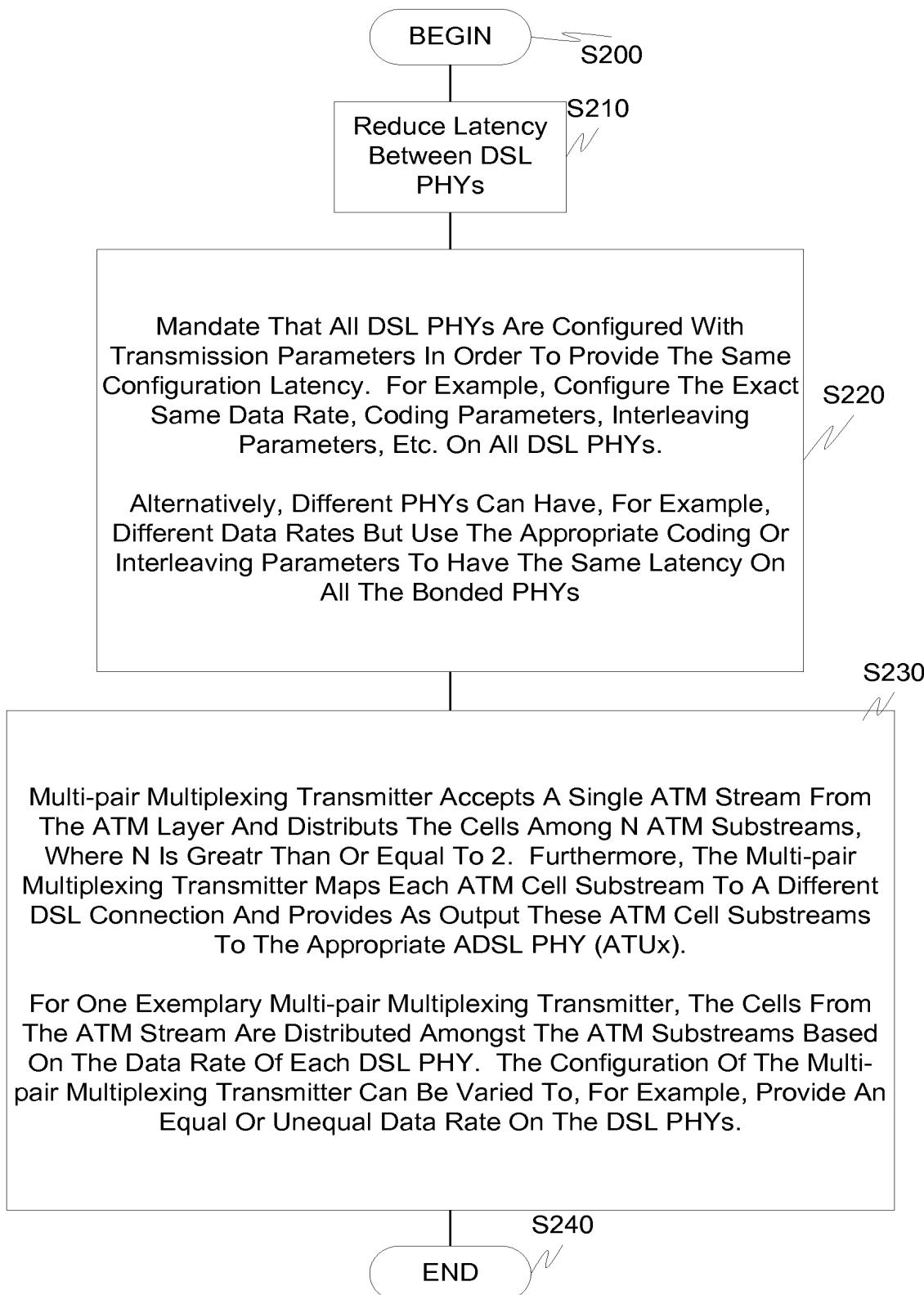


Fig. 16

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The references cited on attached Form PTO-1449 are being called to the attention of the Examiner.

- Copies of the cited non-patent and/or foreign references are enclosed herewith.

Copies of the cited U.S. patents and/or patent applications are enclosed herewith.

Copies of the cited U.S. patents/patent application publications are not enclosed in accordance with 37 C.F.R. § 1.98(a).

Copies of the cited references are not enclosed, in accordance with 37 C.F.R. § 1.98(d), because the references were cited by or submitted to the U.S. Patent and Trademark Office in prior application Serial No. _____ filed _____, which is relied upon for an earlier filing date under 35 U.S.C. § 120.

To the best of applicants' belief, the pertinence of the foreign-language references are believed to be summarized in the attached English abstracts and/or in the figures, although applicants do not necessarily vouch for the accuracy of the translation.

Examiner's attention is drawn to the following related applications:

Serial No. _____ filed _____ (Attorney Ref. No. _____)

Serial No. _____ filed _____ (Attorney Ref. No. _____)

- Other: _____

Submission of the above information is not intended as an admission that any item is citable under the statutes or rules to support a rejection, that any item disclosed represents analogous art, or that those skilled in the art would refer to or recognize the pertinence of any reference without the benefit of hindsight, nor should an inference be

drawn as to the pertinence of the references based on the order in which they are presented. Submission of this statement should not be taken as an indication that a search has been conducted, or that no better art exists.

It is respectfully requested that the cited information be expressly considered during the prosecution of this application and the references made of record therein.

FEES

<input type="checkbox"/>	<p>37 CFR 1.97(b): No fee is believed due in connection with this submission, because the information disclosure statement submitted herewith is satisfied by one of the following conditions ("X" indicates satisfaction):</p> <ul style="list-style-type: none"> <input type="checkbox"/> Within three months of the filing date of a national application other than a continued prosecution application under 37 CFR 1.53(d), or <input type="checkbox"/> Within three months of the date of entry into the national stage of an international application as set forth in 37 CFR 1.491 or <input type="checkbox"/> Before the mailing date of a first Office Action on the merits, or <input type="checkbox"/> Before the mailing of a first Office action after the filing of a request for continued examination under 37 CFR 1.114. <p>Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p>
<input checked="" type="checkbox"/>	<p>37 CFR 1.97(c): The information disclosure statement transmitted herewith is being filed after all the above conditions (37 CFR 1.97(b)), but before the mailing date of one of the following conditions:</p> <ol style="list-style-type: none"> (1) a final action under 37 C.F.R. 1.113 or (2) a notice of allowance under 37 C.F.R. 1.311, or (3) an action that otherwise closes prosecution in the application. <p>This Information Disclosure Statement is accompanied by:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> A Certification (below) as specified by 37 C.F.R. 1.97(e). Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970. <input type="checkbox"/> OR <input type="checkbox"/> Please charge Deposit Account 19-1970 in the amount of \$180.00 for the fee set forth in 37 C.F.R. 1.17(p) for submission of an information disclosure statement. Please credit any overpayment or charge any underpayment to Deposit Account 19-1970.
<input type="checkbox"/>	<p>37 CFR 1.97(d): This Information Disclosure Statement is being submitted after the period specified in 37 CFR 1.97(c).</p> <ul style="list-style-type: none"> <input type="checkbox"/> This information Disclosure Statement includes a Certification (below) as specified by 37 C.F.R. 1.97(e) AND <input type="checkbox"/> Applicants hereby requests consideration of the reference(s) disclosed herein. Please charge Deposit Account 19-1970 in the amount of \$180.00 under 37 C.F.R. 1.17(p). Please credit any overpayment or charge any underpayment to Deposit Account 19-1970. Election to pay the fee should not be taken as an indication that applicant(s) cannot execute a certification.

Certification (37 C.F.R. 1.97(e))
(Applicable only if checked)



The undersigned certifies that:

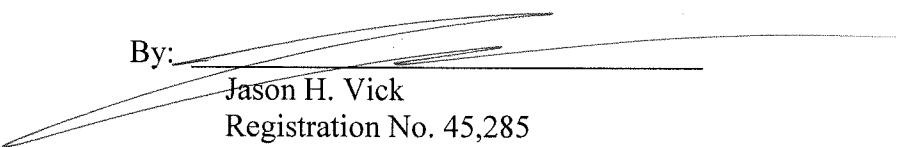
- Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(1).
- A copy of the communication from the foreign patent office is enclosed.

OR

- No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(2).

Respectfully submitted,

SHERIDAN ROSS P.C.

By: 

Jason H. Vick
Registration No. 45,285
1560 Broadway, Suite 1200
Denver, Colorado 80202-5141
(303) 863-9700

Date: 4/5/12

Substitute for form 1449A/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
Sheet	1	of	1	Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Duc Chi Ho
				Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Document Number Number-kind Code ^{2 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ⁵ <i>(if known)</i>	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
					T ⁶

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)					
Examiner Initials*	Cite No. ¹				
	1	Decision to Grant a European Patent Pursuant to Article 97(1) EPC for European Patent Application No. 02778433.9, mailed June 28, 2012 (Attorney Ref.: 5550-16-PEP)			

Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
 United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/783,777	05/20/2010	Marcos C. Tzannes	5550-16-CON-3	7487
62574	7590	08/16/2012	EXAMINER	
Jason H. Vick			HO, DUC CHI	
Sheridan Ross, PC			ART UNIT	PAPER NUMBER
Suite # 1200			2465	
1560 Broadway				
Denver, CO 80202				
NOTIFICATION DATE		DELIVERY MODE		
08/16/2012		ELECTRONIC		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jvick@sheridanross.com

Office Action Summary	Application No.	Applicant(s)	
	12/783,777	TZANNES ET AL.	
	Examiner	Art Unit	
	DUC C. HO	2465	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 11 June 2012.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 5) Claim(s) 15-29 is/are pending in the application.
 - 5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) Claim(s) 20-24 is/are allowed.
- 7) Claim(s) 15-19 and 25-29 is/are rejected.
- 8) Claim(s) _____ is/are objected to.
- 9) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 10) The specification is objected to by the Examiner.
- 11) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 12) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>04-18-2011; 04-08-2011; 05-25-2011; 03-14-2012</u> | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| | 6) <input type="checkbox"/> Other: _____ |

Application/Control Number: 12/783,777
Art Unit: 2465

Page 2

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the steps in claim 15 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Application/Control Number: 12/783,777
Art Unit: 2465

Page 3

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 15-19 and 25-29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 15 is indefinite. There is no correlation between the limitation “utilizing at least one transmission parameter value, for each of the multiple DSL transceivers, to reduce a difference in latency between the multiple DSL transceivers” and “transmitting a plurality ofof twisted pair communication channels.” The same remark applies to claim 25.

Allowable subject matter

3. Claims 20-24 are allowed.

4. Claims 16-19 and 26-29 would be allowable if claim 15 and 25 rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action.

Conclusion

Application/Control Number: 12/783,777
Art Unit: 2465

Page 4

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Duc Ho whose telephone number is (571) 272-3147. The examiner can normally be reached on Monday through Thursday from 7:30 am to 6:00 pm.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Marsha Banks-Harold, can be reached on (571) 272-7905.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (571) 272-2600.

The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

6. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Patent Examiner
/Duc Chi Ho/
08-12-2012

Application/Control Number: 12/783,777
Art Unit: 2465

Page 5

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12783777	TZANNES ET AL.
	Examiner DUC C HO	Art Unit 2465

SEARCHED

Class	Subclass	Date	Examiner
370	395.1; 535; 465 and text. Text search only	12-30-2010	DH
	updated as above	11-15-2011	DH
	updated as above	05-31-2012	DH
	updated as above	07-22-2012	DH
	updated as above	08-12-2012	DH

SEARCH NOTES

Search Notes	Date	Examiner

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
370	465 and text	07-22-2012	DH

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Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
				Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Duc Chi ho
Sheet	1	of	1	Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Document Number Number-kind Code ^{2 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	
/D.H./	1	7068657	06/27/06	Keller-Tuberg		

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ⁵ <i>(if known)</i>	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)						
Examiner Initials*	Cite No. ¹					
/D.H./	2	Official Action for U.S. Patent Application No. 12/769,277, mailed Apr. 13, 2011 (Attorney Ref. No. 5550-16-CON-2)				
/D.H./	3	Notice of Allowance for U.S. Patent Application No. 12/769,277, mailed May 19, 2011 (Attorney Ref. No. 5550-16-CON-2)				

Examiner Signature	/Duc Ho/	Date Considered	08-12-2012
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

EAST Search History**EAST Search History (Prior Art)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L8	153	dsl adj3 transceiver and high adj3 data adj3 rate	US- PGPUB; USPAT	AND	OFF	2012/08/12 23:34
L9	45	dsl adj3 transceiver\$1 and high adj3 data adj3 rate and reduc\$4 adj10 latency	US- PGPUB; USPAT	AND	OFF	2012/08/12 23:36
L10	5	dsl adj3 transceiver\$1 and high adj3 data adj3 rate and reduc\$4 adj10 latency and twisted adj3 pair	US- PGPUB; USPAT	AND	OFF	2012/08/12 23:36
L11	18	dsl adj3 transceiver\$1 and high adj3 data adj3 rate and twisted adj3 pair and latency	US- PGPUB; USPAT	AND	OFF	2012/08/12 23:38
L12	178	dsl adj3 transceiver\$1 and high adj3 data adj3 rate	US- PGPUB; USPAT	AND	OFF	2012/08/12 23:43
L14	16	12 and (dsl adj3 transceiver\$1) with (high adj3 data adj3 rate)	US- PGPUB; USPAT	AND	OFF	2012/08/12 23:44
L27	11	atm adj3 cell adj3 stream and payload and distribut\$4 with dsl and high adj3 (data or rate) and twisted adj3 pair and atm	US- PGPUB; USPAT	AND	OFF	2012/08/13 01:04
L29	11	combin\$4 adj3 (multiple or plurality) adj3 dsl and atm and high adj3 rate	US- PGPUB; USPAT	AND	OFF	2012/08/13 01:07

8/13/2012 1:08:16 AM

Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
				Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Duc Chi ho
Sheet	1	of	1	Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Document Number Number-kind Code ^{2 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ^{5 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)						
Examiner Initials*	Cite No. ¹					
/D.H./	1	Notice of Allowance for Canadian Patent Application No. 2,461,320, dated Feb. 18, 2011 (Attorney Ref. No. 5550-16-PCA)				

Examiner Signature	/Duc Ho/	Date Considered	08-12-2012
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
				Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Duc Chi ho
Sheet	1	of	1	Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Document Number Number-kind Code ^{2 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/D.H./	1	6134246	10/17/00	Cai et al.	

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ^{5 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)						
Examiner Initials*	Cite No. ¹					
/D.H./	2	Official Action for U.S. Patent Application No. 12/769,277, mailed Jan. 10, 2011 (Attorney Ref No. 5550-16-CON-2)				

Examiner Signature	/Duc Ho/	Date Considered	08-12-2012
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
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				Examiner Name	Duc Chi Ho
				Attorney Docket Number	5550-16-CON-3

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/D H /	1	6252878	06/26/2001	Locklear, Jr. et al.	

FOREIGN PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ⁵ <i>(if known)</i>	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
					T ⁶

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)		
Examiner Initials*	Cite No. ¹	

Examiner Signature	/Duc Ho/	Date Considered	08-12-2012
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

Index of Claims		Application/Control No.		Applicant(s)/Patent Under Reexamination	
		12783777		TZANNES ET AL.	
		Examiner		Art Unit	
		DUC C HO		2465	

<input checked="" type="checkbox"/>	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIM		DATE								
Final	Original	12/30/2010	11/15/2011	05/31/2012	07/22/2012	08/12/2012				
	1	✓	-			-				
	2	-	-			-				
	3	-	-			-				
	4	-	-			-				
	5	-	-			-				
	6	-	-			-				
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	11	-	-			-				
	12	-	-			-				
	13	-	-			-				
	14		✓			-				
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12	26			✓	=	✓				
13	27			✓	=	✓				
14	28			✓	=	✓				
15	29			✓	=	✓				

Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
				Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Duc Chi Ho
Sheet	1	of	1	Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS					
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OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)						
Examiner Initials*	Cite No. ¹					
/D.H./	1	Notice of Intent to Grant European patent for European Patent Application No. 02778433.9, dated Feb. 6, 2012 (Attorney Ref. No. 5550-16-PEP)				

Examiner Signature	/Duc Ho/	Date Considered	08-12-2012
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

**REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)**

Application Number	12/783,777	Filing Date	2010-05-20	Docket Number (if applicable)	5550-16-CON-3	Art Unit	2465
First Named Inventor	Marcos C. Tzannes			Examiner Name	HO, DUC CHI		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.

Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

Other _____

Enclosed

Amendment/Reply

Information Disclosure Statement (IDS)

Affidavit(s)/ Declaration(s)

Other _____

MISCELLANEOUS

Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.
 The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to
Deposit Account No 191970 _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Patent Practitioner Signature

Applicant Signature

Signature of Registered U.S. Patent Practitioner

Signature	/Jason H. Vick/	Date (YYYY-MM-DD)	2012-05-15
Name	Jason H. Vick	Registration Number	45285

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:
TZANNES et al.
Serial No.: 12/783,777
Filed: May 20, 2010
Atty. File No.: 5550-16-CON-3
Entitled: "SYSTEMS AND METHODS FOR
MULTI-PAIR ATM OVER DSL")
Group Art Unit: 2465
Confirmation No.: 7487
Examiner: Duc Chi Ho

SUPPLEMENTAL
INFORMATION DISCLOSURE
STATEMENT
Electronically Submitted

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The references cited on attached Form PTO-1449 are being called to the attention of the Examiner.

- Copies of the cited non-patent and/or foreign references are enclosed herewith.
 Copies of the cited U.S. patents and/or patent applications are enclosed herewith.
 Copies of the cited U.S. patents/patent application publications are not enclosed in accordance with 37 C.F.R. § 1.98(a).
 Copies of the cited references are not enclosed, in accordance with 37 C.F.R. § 1.98(d), because the references were cited by or submitted to the U.S. Patent and Trademark Office in prior application Serial No. _____ filed _____, which is relied upon for an earlier filing date under 35 U.S.C. § 120.
 To the best of applicants' belief, the pertinence of the foreign-language references are believed to be summarized in the attached English abstracts and/or in the figures, although applicants do not necessarily vouch for the accuracy of the translation.
 Examiner's attention is drawn to the following related applications:

Serial No. _____ filed _____ (Attorney Ref. No. _____)

Serial No. _____ filed _____ (Attorney Ref. No. _____)

Other: _____

Submission of the above information is not intended as an admission that any item is citable under the statutes or rules to support a rejection, that any item disclosed represents analogous art, or that those skilled in the art would refer to or recognize the pertinence of any reference without the benefit of hindsight, nor should an inference be

drawn as to the pertinence of the references based on the order in which they are presented. Submission of this statement should not be taken as an indication that a search has been conducted, or that no better art exists.

It is respectfully requested that the cited information be expressly considered during the prosecution of this application and the references made of record therein.

FEES

<input checked="" type="checkbox"/>	<p>37 CFR 1.97(b): No fee is believed due in connection with this submission, because the information disclosure statement submitted herewith is satisfied by one of the following conditions ("X" indicates satisfaction):</p> <p><input type="checkbox"/> Within three months of the filing date of a national application other than a continued prosecution application under 37 CFR 1.53(d), or</p> <p><input type="checkbox"/> Within three months of the date of entry into the national stage of an international application as set forth in 37 CFR 1.491 or</p> <p><input type="checkbox"/> Before the mailing date of a first Office Action on the merits, or</p> <p><input checked="" type="checkbox"/> Before the mailing of a first Office action after the filing of a request for continued examination under 37 CFR 1.114.</p> <p>Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p>
<input type="checkbox"/>	<p>37 CFR 1.97(c): The information disclosure statement transmitted herewith is being filed after all the above conditions (37 CFR 1.97(b)), but before the mailing date of one of the following conditions:</p> <p>(1) a final action under 37 C.F.R. 1.113 or (2) a notice of allowance under 37 C.F.R. 1.311, or (3) an action that otherwise closes prosecution in the application.</p> <p>This Information Disclosure Statement is accompanied by:</p> <p><input type="checkbox"/> A Certification (below) as specified by 37 C.F.R. 1.97(e). Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p> <p>OR</p> <p><input type="checkbox"/> Please charge Deposit Account 19-1970 in the amount of \$180.00 for the fee set forth in 37 C.F.R. 1.17(p) for submission of an information disclosure statement. Please credit any overpayment or charge any underpayment to Deposit Account 19-1970.</p>
<input type="checkbox"/>	<p>37 CFR 1.97(d): This Information Disclosure Statement is being submitted after the period specified in 37 CFR 1.97(c).</p> <p><input type="checkbox"/> This information Disclosure Statement includes a Certification (below) as specified by 37 C.F.R. 1.97(e)</p> <p>AND</p> <p><input type="checkbox"/> Applicants hereby requests consideration of the reference(s) disclosed herein. Please charge Deposit Account 19-1970 in the amount of \$180.00 under 37 C.F.R. 1.17(p). Please credit any overpayment or charge any underpayment to Deposit Account 19-1970. Election to pay the fee should not be taken as an indication that applicant(s) cannot execute a certification.</p>

Certification (37 C.F.R. 1.97(e))
(Applicable only if checked)

The undersigned certifies that:

- Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(1).

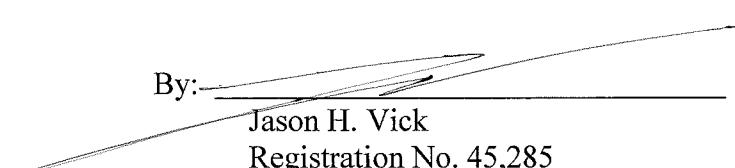
A copy of the communication from the foreign patent office is enclosed.

OR

- No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(2).

Respectfully submitted,

SHERIDAN ROSS P.C.

By: 

Jason H. Vick
Registration No. 45,285
1560 Broadway, Suite 1200
Denver, Colorado 80202-5141
(303) 863-9700

Date: 15 MAY 02

Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
Sheet	1	of	1	Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Duc Chi Ho
				Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Document Number Number-kind Code ^{2 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
1		6252878	06/26/2001	Locklear, Jr. et al.	

FOREIGN PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ^{5 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
					T ⁶

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)		
Examiner Initials*	Cite No. ¹	

Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Patent Application Fee Transmittal				
Application Number:	12783777			
Filing Date:	20-May-2010			
Title of Invention:	SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL			
First Named Inventor/Applicant Name:	Marcos C. Tzannes			
Filer:	Jason Vick/Joanne Vos			
Attorney Docket Number:	5550-16-CON-3			
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 3 months with \$0 paid	1253	1	1270	1270

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Request for continued examination	1801	1	930	930
Total in USD (\$)				2200

Electronic Acknowledgement Receipt

EFS ID:	12779421
Application Number:	12783777
International Application Number:	
Confirmation Number:	7487
Title of Invention:	SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL
First Named Inventor/Applicant Name:	Marcos C. Tzannes
Customer Number:	62574
Filer:	Jason Vick/Joanne Vos
Filer Authorized By:	Jason Vick
Attorney Docket Number:	5550-16-CON-3
Receipt Date:	15-MAY-2012
Filing Date:	20-MAY-2010
Time Stamp:	12:14:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$2200
RAM confirmation Number	10948
Deposit Account	191970
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/Message Digest	Multi Part /.zip	Pages (if appl.)
1		AMEND_02_AF.pdf	520067 67764627e0ec525e61f45d0bc82d888f54d 6ce24	yes	7
Multipart Description/PDF files in .zip description					
Document Description		Start		End	
Amendment Submitted/Entered with Filing of CPA/RCE		1		1	
Claims		2		4	
Applicant Arguments/Remarks Made in an Amendment		5		6	
Extension of Time		7		7	

Warnings:**Information:**

2	Request for Continued Examination (RCE)	RCE_01.pdf	697437 d4900cfaa2157615e37e885ca165459d866 95048	no	3
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Warnings:**Information:**

3		IDS_06.pdf	323190 e5c723f843b3b1a9225c4838e5742d242d d6714	yes	4
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Multipart Description/PDF files in .zip description

Document Description		Start		End	
Transmittal Letter		1		3	
Information Disclosure Statement (IDS) Form (SB08)		4		4	

Warnings:**Information:**

4	Fee Worksheet (SB06)	fee-info.pdf	32303 d1613cac5b12e92bf537cff5b0edaaea92c 7605	no	2
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Warnings:**Information:****Total Files Size (in bytes):** 1572997

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: Marcos C. Tzannes) Group Art Unit: 2465
Application No.: 12/783,777)
) Examiner: HO, Duc Chi
Filed: May 20, 2010)
) Confirmation No.: 7487
Atty. File No.: 5550-16-CON-3)
)

For: SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL

AMENDMENT AFTER FINAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

Applicant submits this Amendment After Final to address the Final Office Action having a mailing date of November 18, 2011. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

Amendments to the Claims are shown in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 5 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-14. (Cancelled)

15. (New) A method to combine multiple DSL transceivers to generate a single high data rate connection between a service provider and a DSL subscriber over a plurality of twisted pair communications channels comprising:

utilizing at least one transmission parameter value, for each of the multiple DSL transceivers, to reduce a difference in latency between the multiple DSL transceivers; and transmitting a plurality of packets or cells from the service provider to the DSL subscriber, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

16. (New) The method of claim 15, further comprising receiving, at the DSL subscriber, the plurality of cells or packets using multiple DSL transceivers.

17. (New) The method of claim 15, wherein the cells are ATM cells.

18. (New) The method of claim 15, wherein the packets are IP packets or Ethernet packets.

19. (New) The method of claim 15, wherein the DSL transceivers are ADSL transceivers or VDSL transceivers.

20. (New) A system, capable of combining multiple DSL transceivers to generate a single high data rate connection between a service provider and a DSL subscriber over a plurality of twisted pair communications channels, comprising:

multiple DSL transceivers, each of the multiple DSL transceivers capable of utilizing at least one transmission parameter value to reduce a difference in latency between the multiple DSL transceivers; and

a plurality of transmitter portions capable of transmitting a plurality of packets or cells from the service provider to the DSL subscriber, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

21. (New) The system of claim 20, further comprising a receiver portion capable of receiving at the DSL subscriber the plurality of cells or packets.

22. (New) The system of claim 20, wherein the cells are ATM cells.

23. (New) The system of claim 20, wherein the packets are IP packets or Ethernet packets.

24. (New) The system of claim 20, wherein the DSL transceivers are ADSL transceivers or VDSL transceivers.

25. (New) A non-transitory computer readable information storage media having stored thereon instructions that when executed cause to be performed a method to combine multiple DSL transceivers to generate a single high data rate connection between a service provider and a DSL subscriber over a plurality of twisted pair communications channels comprising:

utilizing at least one transmission parameter value, for each of the multiple DSL transceivers, to reduce a difference in latency between the multiple DSL transceivers; and

transmitting a plurality of packets or cells from the service provider to the DSL subscriber, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

26. (New) The one or more media of claim 25, further comprising receiving at the DSL subscriber the plurality of cells or packets using multiple DSL transceivers.

27. (New) The one or more media of claim 25, wherein the cells are ATM cells.

28. (New) The one or more media of claim 25, wherein the packets are IP packets or Ethernet packets.

29. (New) The one or more media of claim 25, wherein the DSL transceivers are ADSL transceivers or VDSL transceivers.

REMARKS

Applicant respectfully requests reconsideration of this application as amended.

Claim 14 has been cancelled without prejudice or disclaimer. Claims 15-29 are pending.

By this amendment, Applicant respectfully submits the outstanding rejection of claim 14 in view of APA and Amidan is moot – withdrawal thereof is respectfully requested.

In that the references fail to teach, suggest or disclose the claimed combination of features, the pending claims are allowable.

For example, the references do not teach, suggest nor disclose utilizing at least one transmission parameter value, for each of the multiple DSL transceivers, to reduce a difference in latency between the multiple DSL transceivers, and transmitting a plurality of packets or cells from the service provider to the DSL subscriber, wherein a data rate for a first DSL transceiver of the multiple DSL transceivers is different than a data rate for a second DSL transceiver of the multiple DSL transceivers and wherein the combined multiple DSL transceivers generate the single high data rate connection between the service provider and the DSL subscriber over the plurality of twisted pair communications channels.

With the outstanding rejection having been overcome, Applicant respectfully submits the application is in condition for allowance. A prompt notice of allowance is respectfully solicited.

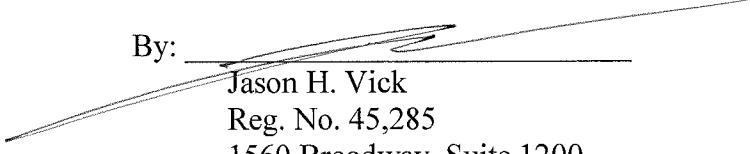
Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is encouraged to contact Applicants undersigned representative at the telephone number listed below.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 15 May 12

By: 

Jason H. Vick
Reg. No. 45,285
1560 Broadway, Suite 1200
Denver, Colorado 80202
Telephone: 303-863-9700

PTO/SB/22 (09-11)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional) 5550-16-CON-3																		
Application Number 12/783,777		Filed May 20, 2010																		
For SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL																				
Art Unit 2465		Examiner HO, Duc Chi																		
This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.																				
The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):																				
<table> <thead> <tr> <th></th> <th><u>Fee</u></th> <th><u>Small Entity Fee</u></th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/> One month (37 CFR 1.17(a)(1))</td> <td>\$150</td> <td>\$75</td> </tr> <tr> <td><input type="checkbox"/> Two months (37 CFR 1.17(a)(2))</td> <td>\$560</td> <td>\$280</td> </tr> <tr> <td><input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))</td> <td>\$1270</td> <td>\$635</td> </tr> <tr> <td><input type="checkbox"/> Four months (37 CFR 1.17(a)(4))</td> <td>\$1980</td> <td>\$990</td> </tr> <tr> <td><input type="checkbox"/> Five months (37 CFR 1.17(a)(5))</td> <td>\$2690</td> <td>\$1345</td> </tr> </tbody> </table>				<u>Fee</u>	<u>Small Entity Fee</u>	<input type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$150	\$75	<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$560	\$280	<input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1270	\$635	<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$1980	\$990	<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$2690	\$1345
	<u>Fee</u>	<u>Small Entity Fee</u>																		
<input type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$150	\$75																		
<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$560	\$280																		
<input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1270	\$635																		
<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$1980	\$990																		
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$2690	\$1345																		
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.																				
<input type="checkbox"/> A check in the amount of the fee is enclosed.																				
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.																				
<input checked="" type="checkbox"/> The Director has already been authorized to charge fees in this application to a Deposit Account.																				
<input checked="" type="checkbox"/> The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>19-1970</u> .																				
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.																				
I am the <input type="checkbox"/> applicant/inventor. <input type="checkbox"/> assignee of record of the entire interest. See 37 CFR 3.71. <input type="checkbox"/> Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96). <input checked="" type="checkbox"/> attorney or agent of record. Registration Number <u>45,285</u> <input type="checkbox"/> attorney or agent under 37 CFR 1.34. <small>Registration number if acting under 37 CFR 1.34</small> _____																				
Signature		Date 15 MAY '12																		
Jason H. Vick		303-863-9700																		
Typed or printed name		Telephone Number																		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875			Application or Docket Number 12/783,777		Filing Date 05/20/2010		<input type="checkbox"/> To be Mailed			
APPLICATION AS FILED – PART I						OTHER THAN SMALL ENTITY				
(Column 1)			(Column 2)		SMALL ENTITY <input type="checkbox"/>		OR			
FOR		NUMBER FILED		NUMBER EXTRA		RATE (\$)		FEE (\$)		
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A		N/A		N/A		N/A		
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))		N/A		N/A		N/A		N/A		
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A		N/A		N/A		N/A		
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 =		*		X \$ =		X \$ =		
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =		*		X \$ =		X \$ =		
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						TOTAL		
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))								TOTAL		
* If the difference in column 1 is less than zero, enter "0" in column 2.										
APPLICATION AS AMENDED – PART II						OTHER THAN SMALL ENTITY				
(Column 1)			(Column 2)		(Column 3)		SMALL ENTITY		OR	
AMENDMENT	05/15/2012		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)	
	Total (37 CFR 1.16(i))		* 15		Minus		** 20		= 0	
	Independent (37 CFR 1.16(h))		* 3		Minus		***3		= 0	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))								X \$ =	
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								OR	
	TOTAL ADD'L FEE								TOTAL ADD'L FEE	
	0								0	
(Column 1)			(Column 2)		(Column 3)		OTHER THAN SMALL ENTITY			
AMENDMENT			CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)	
	Total (37 CFR 1.16(i))		*		Minus		**		=	
	Independent (37 CFR 1.16(h))		*		Minus		***		=	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))								X \$ =	
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								OR	
	TOTAL ADD'L FEE								TOTAL ADD'L FEE	
	0								0	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.										
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".										
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".										
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										
Legal Instrument Examiner: /GAIL WOOTEN/										

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
 United States Patent and Trademark Office
 Address: COMMISSIONER FOR PATENTS
 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/783,777	05/20/2010	Marcos C. Tzannes	5550-16-CON-3	7487
62574	7590	11/18/2011	EXAMINER	
Jason H. Vick			HO, DUC CHI	
Sheridan Ross, PC			ART UNIT	PAPER NUMBER
Suite # 1200			2465	
1560 Broadway				
Denver, CO 80202				
NOTIFICATION DATE		DELIVERY MODE		
11/18/2011		ELECTRONIC		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jvick@sheridanross.com

Office Action Summary	Application No.	Applicant(s)	
	12/783,777	TZANNES ET AL.	
	Examiner	Art Unit	
	DUC C. HO	2465	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 11 August 2011.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 5) Claim(s) 14 is/are pending in the application.
 - 5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) Claim(s) _____ is/are allowed.
- 7) Claim(s) 14 is/are rejected.
- 8) Claim(s) _____ is/are objected to.
- 9) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 10) The specification is objected to by the Examiner.
- 11) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 12) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ . | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| | 6) <input type="checkbox"/> Other: _____ . |

Application/Control Number: 12/783,777
Art Unit: 2465

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Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Admitted Prior Art in figure 1 of the instant application, hereinafter referred to as the APA, in view of Amidan et al. (US 7,203,206), hereinafter referred to as Amidan.

Regarding claim 14, Amidan discloses data partitioning for multi-link transmission. In one type of DSL technology, Very High Speed Digital Subscriber Line (VDSL) transceivers can be configured to carry two parallel subchannels over the same wire pair; and the data rate of one channel is R1, and that of other channel is R2 so that the ratio of the data rates between the two subchannel is N1:N2, see col.1, lines 57-67 (corresponding to wherein a data rate for a first

Application/Control Number: 12/783,777
Art Unit: 2465

Page 3

transceiver of the multiple transceiver is different than a data rate for a second transceiver of the multiple transceivers).

In providing multi-link communication systems with enhanced interleaving of data between subchannels, each of the subchannels may operate at its own rate substantially independent of the other subchannels, depending on the individual subchannel conditions. The transmitter maps each word in the data stream to one of the subchannels, depending on the subchannel rates, so that the data are distributed approximately evenly over all the subchannels. In this manner, the data are shared among the subchannels in proportion to the respective subchannel rates, making optimal use of the available bandwidth, while at the same time achieving good interleaving (corresponding to configured one or more interleaving functions) and minimizing latency (reducing latency), see col.3, lines 26-42. (corresponding to reducing a difference in latency between the multiple transceivers by configuring one or more interleaving functions)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to employ a mechanism of providing good interleaving functions in order to reduce latency in multi-link communication systems into the transceivers of the VDSL transmission systems. The suggestion/motivation for doing so would have been to provide broadband digital data to be transmitted over twisted-pair wire efficiently for type of infrastructure that links most home and small business subscribers to their telephone service providers.

Conclusion

Application/Control Number: 12/783,777
Art Unit: 2465

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4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Duc Ho whose telephone number is (571) 272-3147. The examiner can normally be reached on Monday through Thursday from 7:30 am to 6:00 pm.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Marsha Banks-Harold, can be reached on (571) 272-7905.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (571) 272-2600.

The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Application/Control Number: 12/783,777
Art Unit: 2465

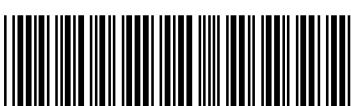
Page 5

6. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Patent Examiner

/Duc Chi Ho/

11-15-2011

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12783777	TZANNES ET AL.
	Examiner	Art Unit
	DUC C HO	2465

SEARCHED

Class	Subclass	Date	Examiner
370	395.1; 535; 465 and text. Text search only	12-30-2010	DH
	updated as above	11-15-2011	DH

SEARCH NOTES

Search Notes	Date	Examiner

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

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EAST Search History**EAST Search History (Prior Art)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L4	19	370/395.1.ccls. and \$1dsl and latency and interleav\$4 and data adj3 rate	US- PGPUB; USPAT	OR	ON	2011/11/14 20:24
L5	12	370/395.1.ccls. and \$1dsl and latency and interleav\$4 and data adj3 rate and transceivers	US- PGPUB; USPAT	OR	ON	2011/11/14 20:25
L6	11	370/535.ccls. and \$1dsl and latency and interleav\$4 and data adj3 rate and transceivers	US- PGPUB; USPAT	OR	ON	2011/11/14 20:27
L7	27	370/465.ccls. and \$1dsl and latency and interleav\$4 and data adj3 rate and transceivers	US- PGPUB; USPAT	OR	ON	2011/11/14 20:29
L8	808	\$1dsl and latency and interleav\$4 and data adj3 rate and transceivers	US- PGPUB; USPAT	OR	ON	2011/11/14 20:30
L11	33	8 and latency adj10 transceivers	US- PGPUB; USPAT	OR	ON	2011/11/14 20:32

11/14/11 8:32:50 PM

C:\Documents and Settings\ DHo\ My Documents\ EAST\ Workspaces\ East-031211.wsp

Index of Claims		Application/Control No.	Applicant(s)/Patent Under Reexamination
		12783777	TZANNES ET AL.
Examiner		Art Unit	
DUC C HO		2465	

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIM		DATE									
Final	Original	12/30/2010	11/15/2011								
	1	✓	-								
	2	-	-								
	3	-	-								
	4	-	-								
	5	-	-								
	6	-	-								
	7	-	-								
	8	-	-								
	9	-	-								
	10	-	-								
	11	-	-								
	12	-	-								
	13	-	-								
	14		✓								

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: Marcos C. Tzannes) Group Art Unit: 2465
Application No.: 12/783,777))
Filed: May 20, 2010) Examiner: HO, Duc Chi
Atty. File No.: 5550-16-CON-3))
) Confirmation No.: 7487
)
)

For: SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL

AMENDMENT AND RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant submits this Amendment and Response to address the Office Action having a mailing date of February 15, 2011. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

Amendments to the Claims are shown in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 3 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-13. (Cancelled)

14. (New) A method to combine multiple transceivers to generate a high data rate connection over a plurality of communications channels comprising:

reducing a difference in latency between the multiple transceivers by configuring one or more interleaving functions,

wherein a data rate for a first transceiver of the multiple transceivers is different than a data rate for a second transceiver of the multiple transceivers.

REMARKS

Applicant respectfully requests reconsideration of this application as amended.

By this amendment claim 1 is cancelled without prejudice or disclaimer.

New claim 14 is presented for examination.

By virtue of the above amendment, Applicant respectfully submits the outstanding rejections are moot. In that the relied upon references fail to teach, suggest or disclose the claimed features, claim 14 is in condition for allowance.

With all rejections being moot, Applicants respectfully submit the application is in condition for allowance. A prompt notice of allowance is respectfully solicited.

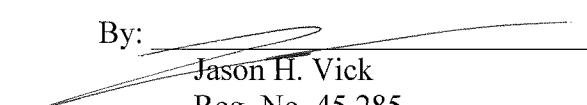
Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is encouraged to contact Applicants undersigned representative at the telephone number listed below.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 11/14/17

By: 

Jason H. Vick

Reg. No. 45,285

1560 Broadway, Suite 1200

Denver, Colorado 80202

Telephone: 303-863-9700

PTO/SB/22 (07-09)

Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional)
FY 2009		
<i>(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)</i>		
Application Number 12/783,777		Filed May 20, 2010
For SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL		
Art Unit 2465		Examiner HO, Duc Chi

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	<u>Fee</u>	<u>Small Entity Fee</u>	
<input type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$130	\$65	\$ _____
<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$490	\$245	\$ _____
<input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1110	\$555	\$ 1110
<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$1730	\$865	\$ _____
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$2350	\$1175	\$ _____

- Applicant claims small entity status. See 37 CFR 1.27.
 - A check in the amount of the fee is enclosed.
 - Payment by credit card. Form PTO-2038 is attached.
 - The Director has already been authorized to charge fees in this application to a Deposit Account.
 - The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 19-1970 .

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the applicant/inventor.

Signature

11 Aug 11

Date

Jason H. Vick

303-863-9700

Typed or printed name

Telephone Number

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Electronic Patent Application Fee Transmittal				
Application Number:	12783777			
Filing Date:	20-May-2010			
Title of Invention:	SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL			
First Named Inventor/Applicant Name:	Marcos C. Tzannes			
Filer:	Jason Vick/Joanne Vos			
Attorney Docket Number:	5550-16-CON-3			
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 3 months with \$0 paid	1253	1	1110	1110

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				1110

Electronic Acknowledgement Receipt

EFS ID:	10719736
Application Number:	12783777
International Application Number:	
Confirmation Number:	7487
Title of Invention:	SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL
First Named Inventor/Applicant Name:	Marcos C. Tzannes
Customer Number:	62574
Filer:	Jason Vick/Joanne Vos
Filer Authorized By:	Jason Vick
Attorney Docket Number:	5550-16-CON-3
Receipt Date:	11-AUG-2011
Filing Date:	20-MAY-2010
Time Stamp:	17:35:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$1110
RAM confirmation Number	4282
Deposit Account	191970
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/Message Digest	Multi Part /.zip	Pages (if appl.)
1		AMEND_01.pdf	290230 1f34711a9088052f2fcadef9903fc33d09ca4f 2f	yes	4
Multipart Description/PDF files in .zip description					
Document Description		Start		End	
Amendment/Req. Reconsideration-After Non-Final Reject		1		1	
Claims		2		2	
Applicant Arguments/Remarks Made in an Amendment		3		3	
Extension of Time		4		4	

Warnings:**Information:**

2	Fee Worksheet (SB06)	fee-info.pdf	30286 783f64a97b78248b6da8790184006ff4dd 0cc36	no	2
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Warnings:**Information:**

Total Files Size (in bytes):	320516
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875			Application or Docket Number 12/783,777		Filing Date 05/20/2010		<input type="checkbox"/> To be Mailed			
APPLICATION AS FILED – PART I						OTHER THAN SMALL ENTITY				
(Column 1)			(Column 2)		SMALL ENTITY <input type="checkbox"/>		OR			
FOR		NUMBER FILED		NUMBER EXTRA		RATE (\$)		FEE (\$)		
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A		N/A		N/A		N/A		
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))		N/A		N/A		N/A		N/A		
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A		N/A		N/A		N/A		
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 =		*		X \$ =		X \$ =		
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =		*		X \$ =		X \$ =		
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.						TOTAL		TOTAL		
APPLICATION AS AMENDED – PART II						OTHER THAN SMALL ENTITY				
(Column 1)			(Column 2)		(Column 3)		SMALL ENTITY		OR	
AMENDMENT	08/11/2011		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)	
	Total (37 CFR 1.16(i))		* 1		Minus		** 20		= 0	
	Independent (37 CFR 1.16(h))		* 1		Minus		***3		= 0	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))									
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
	TOTAL ADD'L FEE		OR		TOTAL ADD'L FEE		RATE (\$)		ADDITIONAL FEE (\$)	
									0	
(Column 1)			(Column 2)		(Column 3)		ADDITIONAL FEE (\$)		RATE (\$)	
AMENDMENT			CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)	
	Total (37 CFR 1.16(i))		* 1		Minus		** 20		= 0	
	Independent (37 CFR 1.16(h))		* 1		Minus		***3		= 0	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))									
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
	TOTAL ADD'L FEE		OR		TOTAL ADD'L FEE		RATE (\$)		ADDITIONAL FEE (\$)	
									0	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.						Legal Instrument Examiner:				
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".						/PATRICIA LEWIS/				
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".										
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/783,777	05/20/2010	Marcos C. Tzannes	5550-16-CON-3	7487
62574	7590	02/15/2011	EXAMINER	
Jason H. Vick			HO, DUC CHI	
Sheridan Ross, PC			ART UNIT	PAPER NUMBER
Suite # 1200			2465	
1560 Broadway				
Denver, CO 80202				
NOTIFICATION DATE		DELIVERY MODE		
02/15/2011		ELECTRONIC		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jvick@sheridanross.com

Office Action Summary	Application No.	Applicant(s)	
	12/783,777	TZANNES ET AL.	
	Examiner	Art Unit	
	DUC C. HO	2465	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 02 August 2010.
 2a) This action is **FINAL**. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 1 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>09-17-10</u> . | 6) <input type="checkbox"/> Other: _____ . |

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Art Unit: 2465

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Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

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2. Claim 1 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 and 9 of U.S. Patent No.7,809,028. Although the conflicting claims are not identical, they are not patentably distinct from each other because

Regarding claim 1, see entire claim (see claim 1 of the patent 7,809,028 at col. 11, lines 45-62).

Regarding claim 1, see entire claim (see claim 9 of the patent 7,809,028 at col. 12, lines 35-52).

The application claim 1 is merely an obvious variation of the patent claim 1. Applicant broadens the scope of the application claim by eliminating the limitation “to reduce a difference in latency between the bonded transceivers, wherein a data rate for a first of the plurality of bonded transceivers is different than a data rate for a second of the plurality of bonded transceivers; and transmitting or receiving a plurality of cells or packets using the plurality of bonded transceivers, wherein an order of the cells is determined by a counter and wherein the plurality of cells are ATM cells and wherein the counter is a cell counter embedded in a header of an ATM cell” in patent claim, lines 53-62.

The application claim 1 is merely an obvious variation of the patent claim 9. Applicant broadens the scope of the application claim by eliminating the limitation “to reduce a difference in latency between the bonded transceivers, wherein a data rate for a first of the plurality of bonded transceivers is different than a data rate for a second of the plurality of bonded transceivers; and transmitting or receiving a plurality of cells or packets using the plurality of bonded transceivers, wherein an order of the cells is determined by a counter and wherein the

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plurality of cells are ATM cells and wherein the counter is a cell counter embedded in a header of an ATM cell" in patent claim, lines 41-52.

It has been held that the omission of an element and its function is an obvious expedient if the remaining elements perform the same function as before. In re Karlson, 136 USPQ 184 (CCPA). Also note Ex Parte Raine, 168 USPQ 375 (bd. App. 1969); therefore omission of a reference element whose function is not needed would be obvious to one skilled in the art.

3. Claim 1 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No.7,453,881. Although the conflicting claims are not identical, they are not patentably distinct from each other because

Regarding claim 1, see entire claim (see claim 1 of the patent 7,453,881 at col. 11, lines 46-52).

The application claim 1 is merely an obvious variation of the patent claim 1. Applicant broadens the scope of the application claim by eliminating the limitations "an ATM stream"; "to reduce latency between the bonded transceivers" in patent claim.

It has been held that the omission of an element and its function is an obvious expedient if the remaining elements perform the same function as before. In re Karlson, 136 USPQ 184 (CCPA). Also note Ex Parte Raine, 168 USPQ 375 (bd. App. 1969); therefore omission of a reference element whose function is not needed would be obvious to one skilled in the art.

4. Claim 1 is provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claim 1 of copending Application No.12/783,777. This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

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Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

6. Claim 1 are rejected under 35 U.S.C. 103(a) as being unpatentable over Admitted Prior Art in figure 1 of the instant application, hereinafter referred to as the APA, in view of Amidan et al. (US 7,203,206), hereinafter referred to as Amidan.

Regarding claim 1, the APA discloses in figure 1 a conventional configuration of a system to transport ATM over DSL. In downstream direction, the VP/VC Mux module 16 and VPI/VCI translation module 14 receive cells from the core network interface element 12 and function to perform cells routing (corresponding to an ATM stream) based on a virtual path identifier (VPI) and/or virtual channel identifier (VCI) to the appropriate ATU-C 18, see pages 1-2. In other words, the routing paths constitute a plurality of ATM sub streams using multiple

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twisted wire pair 1, 2 ...for cells distribution (corresponding to a plurality of ATM sub streams each associated with a multiple twisted wire pair, wherein the ATM stream is distributed between the plurality of ATM substreams).

The APA, however, does not teach a transmitter multi-pair multiplexer module, and a receiver multi-pair multiplexer module.

Amidan discloses data partitioning for multi-link transmission. Transmitter 60 includes a multi-pair multiplexing 66-fig.5, see col.10-line 65 to col.11-line 52.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to employ a multi-pair multiplexing as a transmitter and as a receiver as taught by Amidan into the system of the APA. The suggestion/motivation for doing so would have been to provide a plurality of subschannels having respective subschannel rates, thereby minimizing data latency and buffering requirements associated with multiplexing data over different subchannels.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Rahman et al.(US 6,002,670); Cam et al.(US 5,875,192) are cited to show system and methods for multi-pair ATM over DSL, which is considered pertinent to the claimed invention.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Duc Ho whose telephone number is (571) 272-3147. The examiner can normally be reached on Monday through Thursday from 7:30 am to 6:00 pm.

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If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel, can be reached on (571) 272-2988.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (571) 272-2600.

The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

9. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Patent Examiner

/DUC C HO/

Primary Examiner, Art Unit 2465

12-30-2010

Notice of References Cited		Application/Control No.	Applicant(s)/Patent Under Reexamination	
		12/783,777	TZANNES ET AL.	
Examiner		Art Unit		Page 1 of 1
DUC C. HO		2465		

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,002,670	12-1999	Rahman et al.	370/238
*	B	US-5,875,192	02-1999	Cam et al.	370/395.7
*	C	US-7,809,028	10-2010	Tzannes et al.	370/535
*	D	US-7,453,881	11-2008	Tzannes et al.	370/395.1
*	E	US-7,203,206	04-2007	Amidan et al.	370/474
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims		Application/Control No.	Applicant(s)/Patent Under Reexamination
		12783777	TZANNES ET AL.
Examiner		Art Unit	
DUC C HO		2465	

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant	<input type="checkbox"/> CPA	<input type="checkbox"/> T.D.	<input type="checkbox"/> R.1.47
CLAIM		DATE	
Final	Original	12/30/2010	
	1	✓	

Substitute for form 1449A/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
				Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Ho, Duc Chi
Sheet	1	of	3	Attorney Docket Number	5550-16-CON-3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Document Number Number-kind Code ^{2 (if known)}	Publication Date MM-DD-YYYY	Name of Patentee of Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/D.H./	1	5287513	02/15/94	Ferguson	
/D.H./	2	5684958	11/04/97	Adachi et al.	
/D.H./	3	6222858	04/24/01	Counterman	
/D.H./	4	6258878	07/10/01	Bahadur et al.	
/D.H./	5	6286049	09/04/01	Rajakarunanayake et al.	
/D.H./	6	6731678	05/04/04	White et al.	
/D.H./	7	6771671	08/03/04	Fields et al.	
/D.H./	8	6775305	08/10/04	Delvaux	
/D.H./	9	7023829	04/04/06	Holmquist et al.	
/D.H./	10	7154895	12/26/06	Bornemisza et al.	
/D.H./	11	7453881	11/18/08	Tzannes et al.	
/D.H./	12	2002/0006128	01/17/02	Yehuda et al.	
/D.H./	13	2002/0181458	12/05/02	Amidan et al.	
/D.H./	14	2009/0028158	01/29/09	Tzannes et al.	
/D.H./	15	2010/0208737	08/19/10	Tzannes et al.	

FOREIGN PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ ; Number ⁴ ; Kind Code ⁵ (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/D.H./	16	WO 01/63859	08/30/01	Telica Inc	
/D.H./	17	WO 97/29559	08/14/97	Stanford Telecomm Inc	

Examiner Signature	/Duc Ho/	Date Considered	12-30-2010
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute for form 1449A/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
				Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Ho, Duc Chi
Sheet	2	of	3	Attorney Docket Number	5550-16-CON-3

OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.)			
Examiner Initials*	Cite No. ¹		
/D.H./	18	International Search Report For International (PCT) Patent Application No. PCT/US02/31649, Date of Mailing March 24, 2003, (Attorney's Ref. No. 5550-16-PCT)	
/D.H./	19	Written Opinion for International (PCT) Patent Application No. PCT/US02/31649, mailed November 7, 2003 (Attorney's Ref. No. 5550-16-PCT)	
/D.H./	20	International Preliminary Examination Report for International (PCT) Patent Application No. PCT/US02/31649, Date of Mailing March 5, 2004 (Attorney's Ref. No. 5550-16-PCT)	
/D.H./	21	Supplementary European Search Report for European Patent Application No. EP02778433 (Attorney's Ref. No. 5550-16-PEP)	
/D.H./	22	Official Action for European Patent Application No. EP02778433, mailed April 13, 2010 (Attorney's Ref. No. 5550-16-PEP)	
/D.H./	23	Official Action for Canadian Patent Application No. 2,461,320, mailed June 10, 2008 (Attorney's Ref. No. 5550-16-PCA)	
/D.H./	24	Official Action for Canadian Patent Application No. 2,461,320, mailed September 28, 2009 (Attorney's Ref. No. 5550-16-PCA)	
/D.H./	25	Official Action for U.S. Patent Application No. 10/264,258, mailed October 18, 2006 (Attorney's Ref No. 5550-16)	
/D.H./	26	Official Action for U.S. Patent Application No. 10/264,258, mailed April 27, 2007 (Attorney's Ref No. 5550-16)	
/D.H./	27	Official Action for U.S. Patent Application No. 10/264,258, mailed January 28, 2008 (Attorney's Ref No. 5550-16)	
/D.H./	28	Notice of Allowance for U.S. Patent Application No. 10/264,258, mailed September 23, 2008 (Attorney's Ref No. 5550-16)	
/D.H./	29	Official Action for U.S. Patent Application No. 12/247,741, mailed November 20, 2009 (Attorney's Ref No. 5550-16-CON)	
/D.H./	30	Official Action for U.S. Patent Application No. 12/247,741, mailed April 14, 2010 (Attorney's Ref No. 5550-16-CON)	
/D.H./	31	Notice of Allowability for U.S. Patent Application No. 12/247,741, mailed Jul. 29, 2010 (Attorney Ref No. 5550-16-CON)	

Examiner Signature	/Duc Ho/	Date Considered	02-07-2011
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute for form 1449A/PTO				<i>Complete if Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/783,777
Sheet	3	of	3	Filing Date	May 20, 2010
				First Named Inventor	Marcos C. Tzannes
				Art Unit	2465
				Examiner Name	Ho, Duc Chi
				Attorney Docket Number	5550-16-CON-3

/D.H./	32	Supplemental Notice of Allowability for U.S. Patent Application No. 12/247,741, mailed Aug. 3, 2010 (Attorney Ref No. 5550-16-CON)
/D.H./	33	Notice of Allowability for U.S. Patent Application No. 12/247,741, mailed Aug. 27, 2010 (Attorney Ref No. 5550-16-CON)

Examiner Signature	/Duc Ho/	Date Considered	02-07-2011
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*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

EAST Search History**EAST Search History (Prior Art)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L10	345	370/535.ccls. and atm and multiplex\$4	US- PGPUB; USPAT	OR	ON	2010/12/30 14:29
L11	164	10 and pair	US- PGPUB; USPAT	OR	ON	2010/12/30 14:29
L12	4	10 and pair and substreams	US- PGPUB; USPAT	OR	ON	2010/12/30 14:29
L13	54	10 and twisted adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 14:30
L14	7	10 and (twisted adj3 pair) with atm	US- PGPUB; USPAT	OR	ON	2010/12/30 14:30
L15	8	370/535.ccls. and atm and multiplex\$4 and multi adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 16:23
L16	8	370/395.1.ccls. and atm and multiplex\$4 and multi adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 16:29
L17	84	atm and multiplex \$4 and multi adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 16:31
L18	29	atm with dsl and multi adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 18:29
L19	115	atm and multi adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 20:15
L20	66	19 and multiplex \$4 with (multi or pair)	US- PGPUB; USPAT	OR	ON	2010/12/30 20:15

L21	15493	pair near10 multiplex\$4	US- PGPUB; USPAT	OR	ON	2010/12/30 20:23
L22	19302	pair\$1 near50 multiplex\$4	US- PGPUB; USPAT	OR	ON	2010/12/30 20:23
L23	25	(multi adj3 pair \$1) near50 multiplex\$4	US- PGPUB; USPAT	OR	ON	2010/12/30 20:24
L24	12	(multi adj3 pair \$1) adj5 multiplex \$4	US- PGPUB; USPAT	OR	ON	2010/12/30 20:24
L26	1659	invers\$4 adj3 multiplex\$4	US- PGPUB; USPAT	OR	ON	2010/12/30 20:53
L27	21	26 and atm and multi adj3 pair	US- PGPUB; USPAT	OR	ON	2010/12/30 20:53

12/30/10 8:56:24 PM

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SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/783,777	05/20/2010 RULE	370	2465	5550-16-CON-3

APPLICANTS

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Edmund Reiter, Lincoln, MA;
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** CONTINUING DATA *****

This application is a CON of 12/769,277 04/28/2010
which is a CON of 12/247,741 10/08/2008 PAT 7,809,028
which is a CON of 10/264,258 10/04/2002 PAT 7,453,881
which claims benefit of 60/327,440 10/05/2001

** FOREIGN APPLICATIONS *****

** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **
05/28/2010

Foreign Priority claimed	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
35 USC 119(a-d) conditions met	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Initials	CA	7	1	1

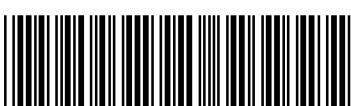
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UNITED STATES

TITLE

SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12783777	TZANNES ET AL.
	Examiner	Art Unit
	DUC C HO	2465

SEARCHED

Class	Subclass	Date	Examiner
370	395.1; 535; 465 and text. Text search only	12-30-2010	DH

SEARCH NOTES

Search Notes	Date	Examiner

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

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